A STUDY OF THE PETROLOGY AND PETROPHYSICS OF THE BLACK SWAN KOMATIITE, EASTERN GOLDFIELDS, WESTERN AUSTRALIA

By

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ABSTRACT

The Black Swan Project, situated some 43 km south of northeast of Kalgoorlie in Western Australia, formed a case study for an assessment of the petrophysical properties of the Black Swan Succession. The Succession hosts a number of discrete magmatic nickel sulphide bodies and associated disseminated mineralization. The study was undertaken with the aim of establishing possible vectors to ore within the project area and potentially elsewhere in the Yilgarn Craton.

Komatiite flows that host mineralization were examined using a proprietary downhole logging system, OMS-LOGG, which recorded magnetic susceptibility, inductive conductivity, resistivity, natural gamma and gamma-gamma readings on selected diamond drill core samples sourced from both trough and flanking channel environments. Hand-held magnetic susceptibility, specific gravity and conductivity readings were taken from both ore-grade material and host rock lithologies, and a number of representative drillcore samples described in terms of mineralogy, geology and geomechanical data. This information was then used to relate the geophysical properties to individual lithological units.

However, establishing such relationships proved difficult, as the variable metamorphic influences within the Black Swan Succession have resulted in wide-ranging and inhomogeneous mineralogical assemblages, with complex distribution and composition of magnetic oxide minerals.

In general, potentially mineralised trough environments were characterized by high conductivity and a higher density. Carbonate was the most abundant mineral in this environment. Conversely, the channel flanks had lower conductivities, and lower density readings, while chlorite was the primary mineral constituent.

Susceptibility readings returned similar ranges in both environments, indicating the technique could not be used as a discriminator. No correlation was noted between manual estimations of magnetite content and magnetic susceptibility or between manual estimates of opaque mineral percentages and magnetic susceptibility. A weak

inverse linear relationship was noted between the percentage of opaque material and the gamma-gamma readings in downhole logs.

CHAPTER ONE

Introduction

1.0 INTRODUCTION

The Black Swan Succession is located in the Eastern Goldfields province of Western Australia, some 43 kms northeast of Kalgoorlie on the Kurnalpi (SH-51-10) 1:250,000 and Gindalbie (3237) 1:100,000 scale map sheets. The Black Swan Succession is host to a number of discrete magmatic nickel sulphide bodies and associated disseminated NiS mineralisation, namely Silver Swan, Silver Swan Deeps, Cygnet, Black Swan, Black Duck, Wood Duck, White Swan and 11200mN. The exploration and development project encompassing these bodies is known as the Black Swan Project.

The surficial character of the Black Swan Project area is dominated by salt lakes and transported or residual lateritic soils with extremely limited outcrop exposure (Hicks & Balfe, 1998). Thus, much of the geological and structural knowledge of the area has been largely derived from geophysical interpretations of airborne and ground magnetic surveys and subsequently by systematic follow-up exploration drilling.

The Black Swan Project forms a case study for an assessment of the petrophysical properties of the Black Swan Succession in relation to the petrology and mineralogy of the package, with the aim of establishing possible vectors to ore within the project area and potentially elsewhere in the Yilgarn Craton. This will be done by attempting to geophysically typecast Komatiite flows hosting mineralisation, so as to discriminate the channel from the flanks of the flows and thus provide vectors to nickel sulphide mineralisation. Given the expense of close-spaced drilling programs, and the necessity for high cost diamond drilling to elucidate geology and structure in areas of limited outcrop, geophysical techniques could significantly reduce exploration costs, particularly if the methods utilised are specifically keyed to the geology of a project.

This study requires an understanding of Komatiite formation processes, effects of deformation and metamorphism on the mineralogy of the flows, and a grasp of the different geophysical methods that could be used within boreholes to identify changes in flow morphology. From this background, individual units within the flow can be typecast petrophysically, and the resultant readings compared to petrographic and mineralogical descriptions to determine if the mineralogy and petrology have a major effect on the petrophysics.

1.1 Definition of a Komatiite

A Komatiite is a rock, crystallised from ultramafic lava, which has an MgO content in excess of 18-weight %, and is characterised by the presence of spinifex textures, distinctive growths of skeletal olivine or pyroxene (Arndt & Nisbet, 1982). Komatiitic basalts have MgO contents typically in the range of 12 - 18% and are also characterised by spinifex textures.

Komatiite lavas have been interpreted by Huppert *et al.* (1984) to have erupted at very high temperatures of between 1400–1650^{0}C, and to have had viscosities ranging from 0.1 – 10 Pas. The flows typically form broad thin sheets of lava. (Hill *et al.*, 1995).

1.2 Komatiite Textures

Komatiites display a wide range of textures produced by variations in the crystal habits of olivine and pyroxene. Dendritic or spinifex textures form when olivine develops a variety of skeletal habits; while cumulate textures arise from accumulations of approximately equigranular crystals (Hill *et al.*, 1990). Cumulate textures predominate and only a small proportion of Komatiites display spinifex textures. Komatiite textures are indicative of the crystallization conditions prevailing: rapid cooling and high degrees of super cooling produce fine random spinifex texture, moderate cooling rates give rise to coarse spinifex textures, and, slow cooling rates result in polyhedral cumulus-textured olivine. Accumulates form in dynamic regimes with rapid turbulent flow of lava, under conditions where temperatures at the site of crystallisation never dropped far below the liquidus (Hill *et al.*, 1990).

Olivine spinifex textures commonly take two forms: platy, skeletal crystals orientated in either random or parallel platy arrays, the latter having grown downwards from a flow top into cooling K omatiite liquid (Hill *et al.*, 1990). A schematic representation of textural patterns shown by a typical thin spinifex textured flow from the Southern Flanking Zone of the Black Swan Succession is presented in figure 1.1.

The spinifex zone is characterised from the top to the base by:

- a brecciated chilled flow top (the A1 Zone);

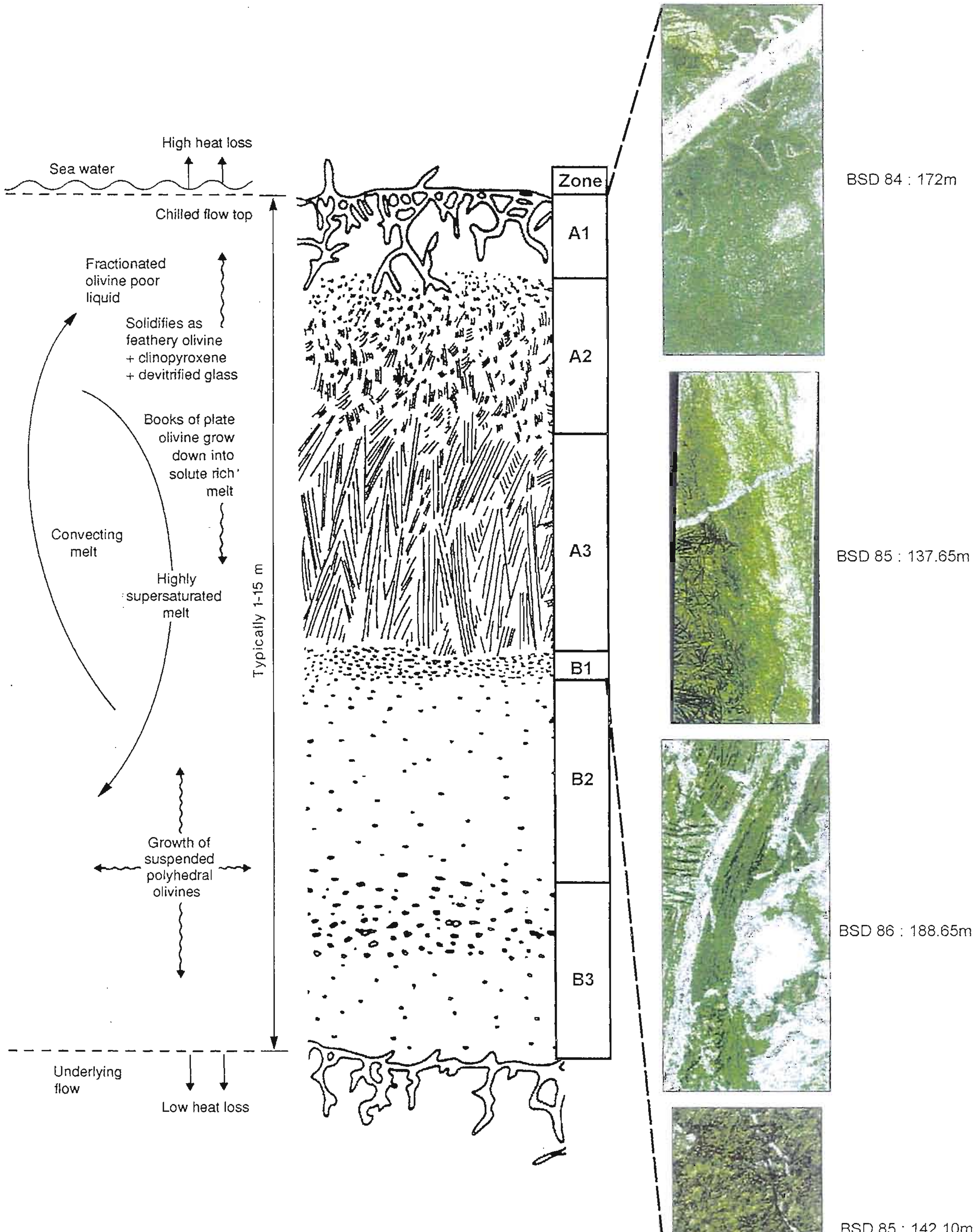


Figure 1.1 Schematic representation of textural patterns exhibited by typical spinifex-textured flows (after Arndt et al. 1977), compared with photographs of drill core through the southern flanking zone of the Black Swan Succession.

- a layer of coarse olivine plates, aligned normal to the flow top (the A3 Zone); and,
- a cumulate-textured zone (the B zone).

The individual zones may vary in thickness from tens of centimetres to many tens of metres (Hill *et al.*, 1990).

In less magnesium rich rocks, spinifex textures are commonly defined by needle like pyroxene crystals (Hill *et al.*, 1990). The layered structure of these flows is similar to that of olivine spinifex-textured flows. A schematic representation of patterns exhibited by a typical pyroxene textured flow is presented in figure 1.2.

Pyroxene spinifex zones are characterised, from the top to the base by:

- a flow top breccia;
- a zone of randomly orientated olivine wafers generally 2 - 3 mm in size with sheaves of fine-grained clinopyroxene and glass interstitial to the olivine;
- a unit with pyroxene spinifex-textures: a "stringy beef" zone with random zones above and below it;
- a thin (0.3m) orthopyroxene-rich layer; and,
- a cumulate unit containing equant, solid to skeletal olivine crystals with clinopyroxene overgrowths and subhedral, solid crystals of clinopyroxene $\pm$ orthopyroxene (Hill *et al.*, 1995).

Below the A3 zone lie cumulate textured units known as the B Zone. A thin zone, the B1 Zone, may exist just below the A zone and consists of aligned or foliated hopper bladed olivine crystals.

A range of textures exists within the cumulate or B zone (figure 1.3). These textures are subdivided on the basis of the proportion of cumulus crystals to the crystallisation products of magma trapped between (interstitial to) the cumulus crystals (Hill *et al.*, 1995), and are outlined below:

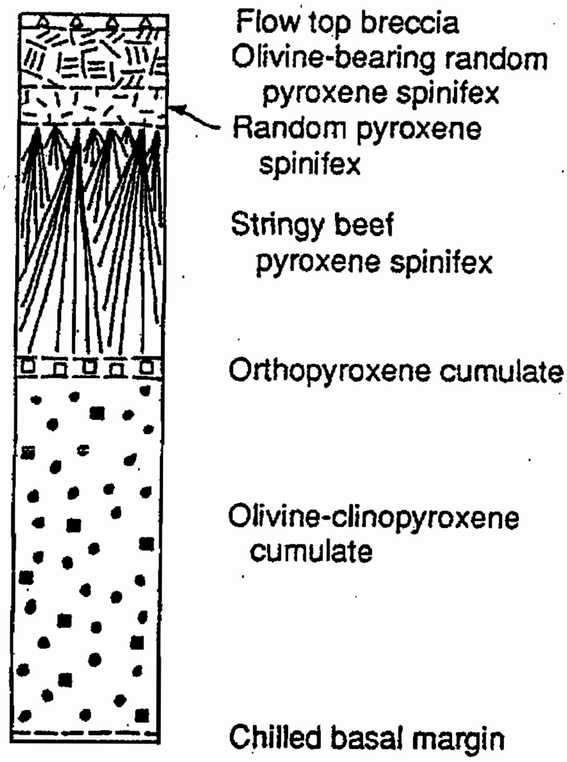
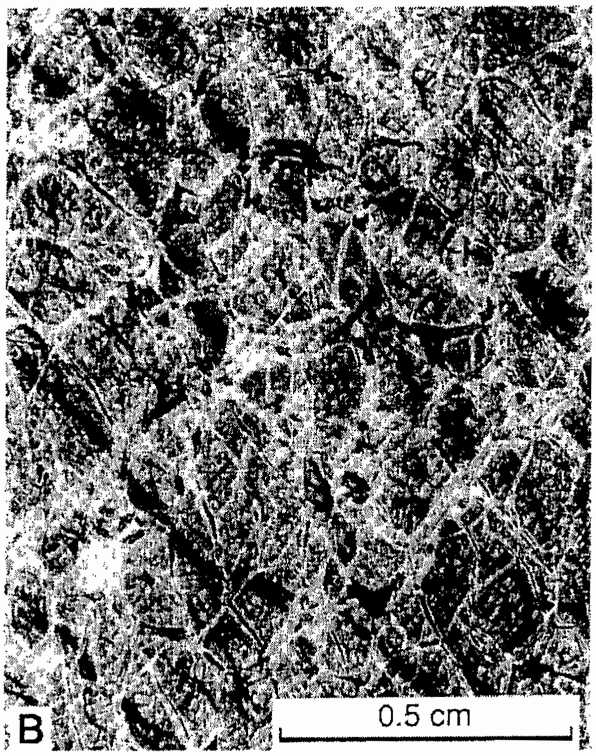
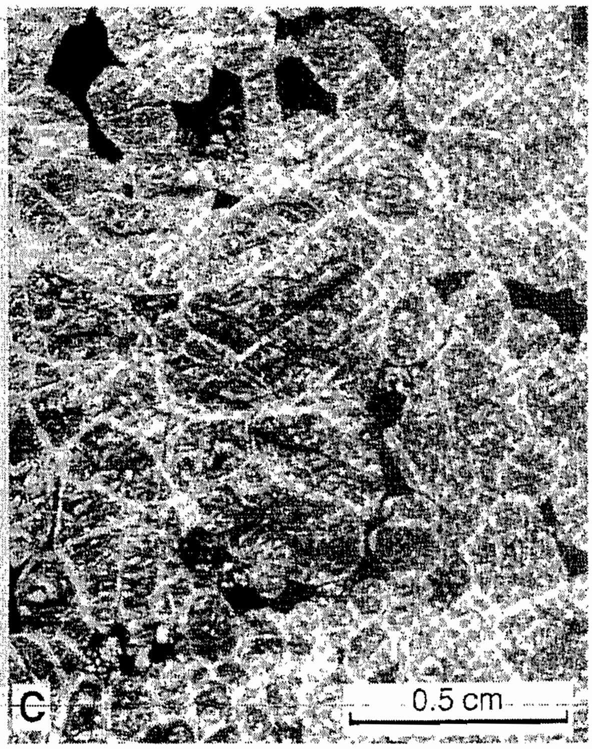


Figure 1-2 Profile through pyroxene spinifex-textured komatiite flow showing textural variation. After Hill et al. (1997).

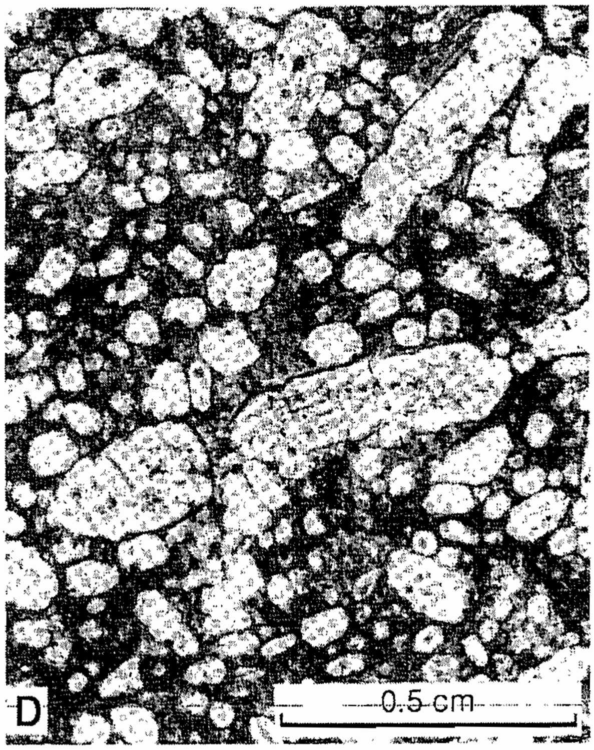
A. Olivine adcumulate



B. Olivine mesocumulate



C. Olivine-sulfide mesocumulate



D. Olivine orthocumulate

Figure 1.3 Komatiite olivine cumulate textures. (After Hill et al., 1990.)

Orthocumulates exhibit a high proportion of crystallised-trapped intercumulus liquid between subhedral to euhedral cumulus crystals.

Mesocumulates, in which the cumulus crystals display extensive mutual boundary, contacts but which retain some recognisable primary igneous porosity.

Accumulates, which have little or no intercumulus material and are characterised by anhedral crystals showing a very high degree of mutual boundary contact and triple point junctions.

Olivine harrisite is a term given to a rock, which is a special case of transition from orthocumulate towards spinifex texture and is characterised by coarse, branching dendritic olivine crystals. This rock type is noted within the Black Swan Komatiite and is believed to be indicative of ponding of lava.

Figures 1.4a and 1.4b illustrate the changes in olivine morphology as a function of supersaturation or extent of under cooling of the Komatiite melt.

Donaldson (1976) demonstrated that the degree of supercooling also affects crystal morphology. Increases in either the rate of cooling or degree of super cooling have a consistent and obvious effect on the habit of the olivine crystals formed. This is illustrated in Figure 1.5. As noted by Hill (1996), slow cooling rates give rise to low degrees of supercooling. In this situation, a small number of nuclei grow slowly to form polyhedral olivine shapes. As the cooling rate increases, the liquid becomes progressively more supercooled (and hence more supersaturated) before crystals begin to form, and the olivine crystals become increasingly skeletal and elongate as the growth-rate increases. There is thus a progression from polyhedral to hopper, elongate-skeletal, chain-like, platy and dendritic crystals with an increase in cooling rate or degree of super cooling.

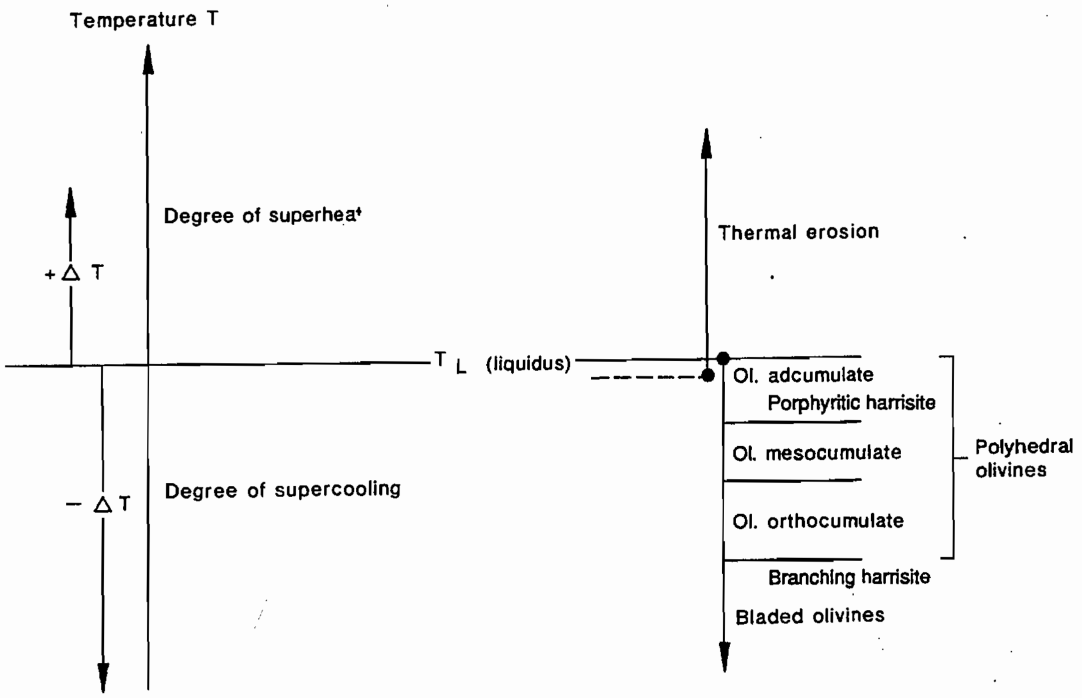


Figure 1.4a Relationship between the degree of supercooling, and the development of olivine adcumulate, mesocumulate, orthocumulate and bladed textures.

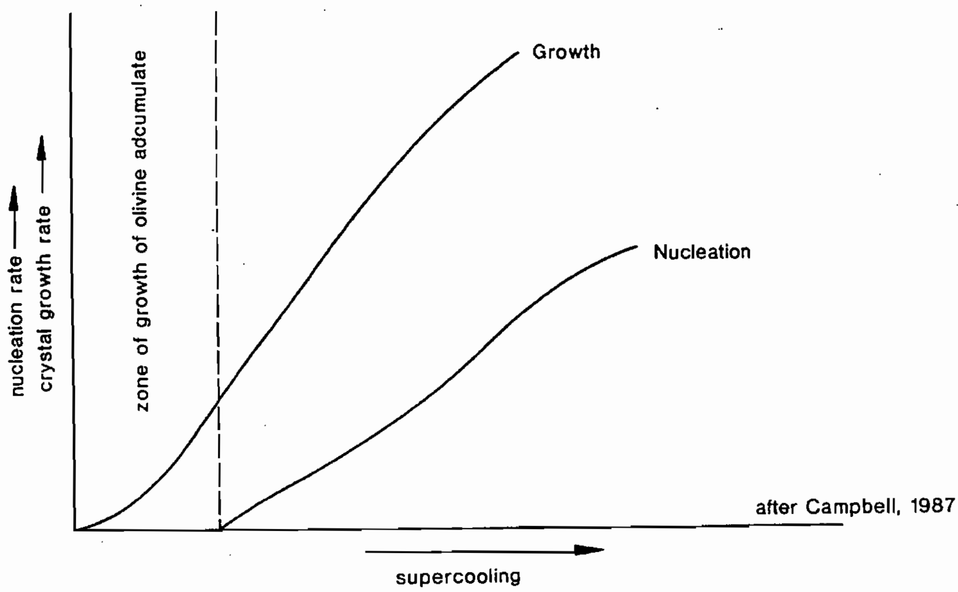


Figure 1.4b Simplified diagram showing the relationships between degree of supercooling, rate of crystal growth and the rate of nucleation. Conditions favouring the crystallisation of olivine adcumulates are highlighted. (After Hill et al., 1990.)

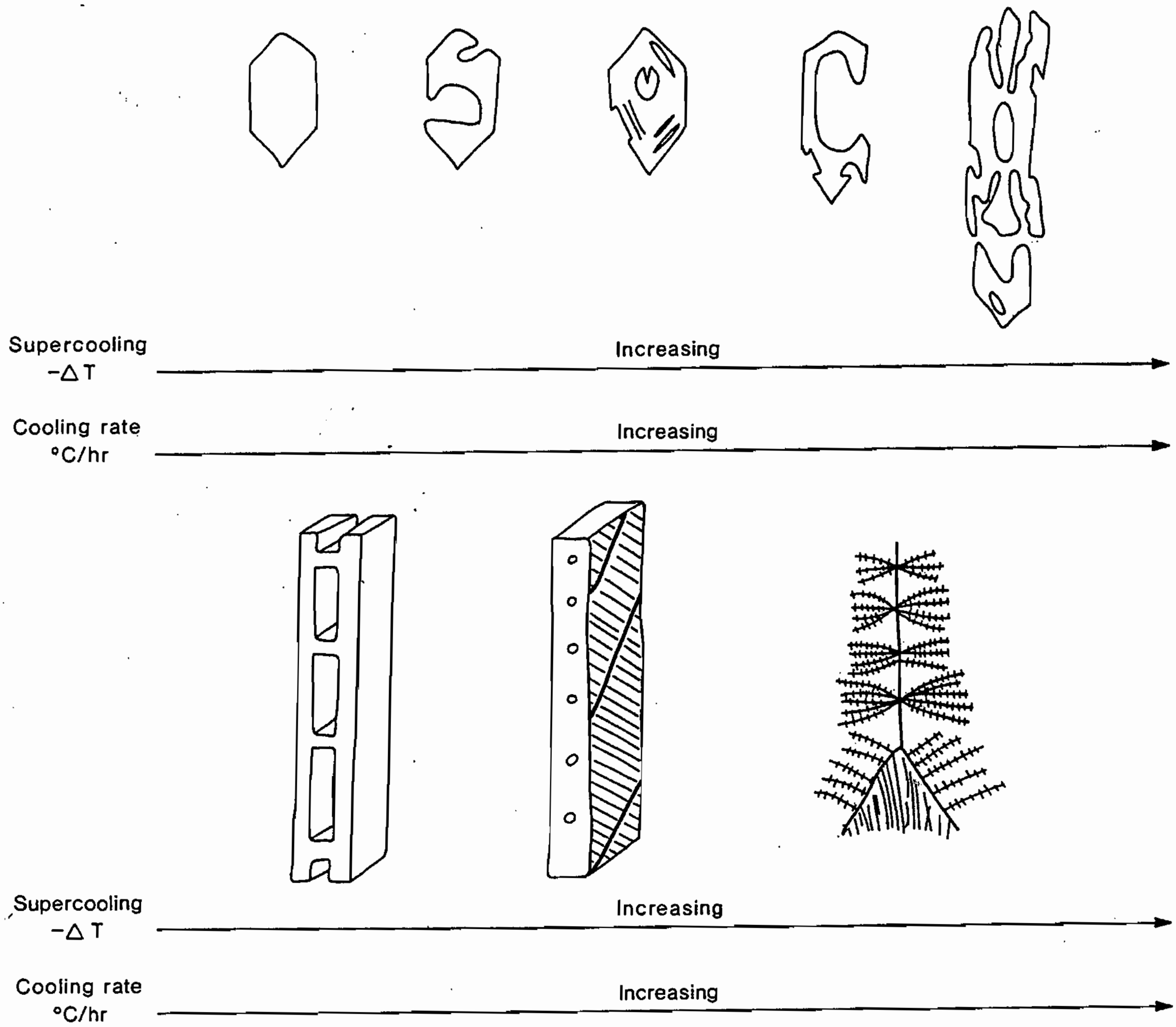


Figure 1.5 Variations in morphology of olivine crystals grown from mafic melts, as a function of cooling rate and degree of supercooling at the time of olivine nucleation. (Redrawn by Hill et al., 1990 after Donaldson, 1976.)

1.3 Komatiite Flow Facies

Characteristic assemblages and arrangement of rock types relate to distinctive volcanic environments or facies, which have been classified by Hill *et al.* (1996) are described in Table 1.1

TABLE 1.1. Komatiite Flow Facies and Volcanic Environments (after Hill *et al.*, 1996)

Facies	Description	Example
Flood Flow	Unconstrained continuous sheet flow of lava to produce thick (up to 500m) sheet-like layered oAC* bodies and layered ultramafic-gabbro sequences.	Walter Williams Formation in the Norseman Wiluna Greenstone Belt
	Continuous sheet flow with preferred flow pathways, probably erosional channels, giving rise to regionally persistent concordant sheet-like units of oOC* (100-200m thick) with occasional spinifex textured flow tops, which flank substantially thicker trough-shaped bodies of layered coarse grained *oAC up to 1km thick and 2km wide, referred to as "dunite lenses".	Agnew-Wiluna Greenstone Belt, WA Mt Keith Ultramafic Complex Perseverance Ultramafic Complex Forrestania Greenstone Belt, WA Eastern, Central, Western Ultramafic Units at Forrestania
Compound Flow	Episodic sheet flows comprising preferred lava pathways flanked by marginal compound flow lobes, giving rise to linear trough-shaped features >10km long, up to 200m wide and up to 150m thick, comprised of *oMC and *oOC with minor harrisite layers and thin spinifex –textured flow tops, flanked by sequences of thinner (10-100m) differentiated spinifex textured flow units and interflow sediments.	Silver Lake Member, Kambalda, WA **Northern Lava Pathway and Black Swan Lava Pathway, Lower Ultramafic Unit, Black Swan Succession, WA**
	Thin episodically emplaced compound flow lobes comprising thin differentiated and undifferentiated flow units between 50cm and 10m thick and tens to hundreds of metres wide, with no obvious internal pathways.	Munro Township, the Komati River valley, Barberton Mountainland
Ponded Flow	Extensive sheet-like cumulate bodies derived from fractionated Komatiite magmas. Lithologies include pyroxenites and gabbros formed by in situ crystallisation of ponded lava lakes.	Kurrajong, Walter Williams Formation

*oAC – olivine adcumulate, * oMC – olivine mesocumulate, *oOC – olivine orthocumulate*

Taken from Dowling & Hill (1998), Figure 1.6 is a highly schematic generalised plan and sections of a portion of a large Komatiite volcanic complex, which incorporates different depositional environments. The actual volcanic complex can vary from a few kilometres to hundreds of kilometres in aerial extent.

Figure 1.7 show a schematic representation of a portion of a Komatiite flow field according to Hill *et al.* (2000). This model illustrates the relationships of volcanic facies as components of a single sustained sheet-flow eruption. Fundamental features of this model are a constant long-lived lava flow, inflation of sheet flow units under composite visco-elastic and brittle crusts, and the development of preferred lava pathways (channel) or tubes.

1.4 Metamorphism of Komatiites

The nature of the mineralogical assemblage that develops during metamorphism is controlled by the primary igneous composition of the rocks, the P-T conditions of metamorphism, and the ratio of H_2O to CO_2 in the metamorphic fluid (Hill, 1996).

The chemical substitution series:

$$\text{CaFMASCH } (CaO\text{-}FeO\text{-}MgO\text{-}Al_2O_3\text{-}SiO_2\text{-}CO_2\text{-}H_2O)$$

can be used to explain metamorphic phase equilibrium in komatiitic rocks (Hill, 1989). In this system, FeO substitutes for MgO in most mineral assemblages without affecting the stability of the resultant mineral. During metamorphism of a Komatiite, chlorite is formed at low temperature and pressure gradients, and then remains stable over almost all metamorphic grades. It is formed from metamorphism of all Komatiite bulk compositions, and uses the majority of the Al_2O_3 in the original rock. Hill (1991) reported that the Al content of the Komatiite, and therefore, the proportion of chlorite in the metamorphosed rock, was exactly proportional to the amount of Komatiite liquid relative to the amount of cumulus olivine. The cumulus olivine in the Komatiite contains little Al, while the Al content of Komatiite liquids ranges between 5 and 10% Al_2O_3. Thus, the modal chlorite content of the rock is in direct proportion to the olivine content, and can be used as a reliable predictor of the original bulk composition of the Komatiite.

Alteration occurring prior to the onset of regional prograde metamorphism results in the serpentinisation of olivine and the hydration of the glassy groundmass. Serpentinites commonly consist of antigorite and/or lizardite with minor chrysotile. Serpentine minerals are unstable in the presence of minor fluids with minor proportions of CO_2. During prograde metamorphism dehydration results in the breakdown of low temperature alteration products. During greenschist facies metamorphism, lizardite and chrysotile serpentine give way to antigorite. Such reactions tend to obliterate igneous textures.

The talc content of a rock is influenced by the original rock composition and the amount of fluid influxing. If the rock reacts with large volumes of fluid, leading to the completion of the reaction, then the rock is converted to a quartz-carbonate-chlorite assemblage. Smaller influx of fluids results in a talc + magnesite + chlorite assemblage (Hill *et al.*, 1999).

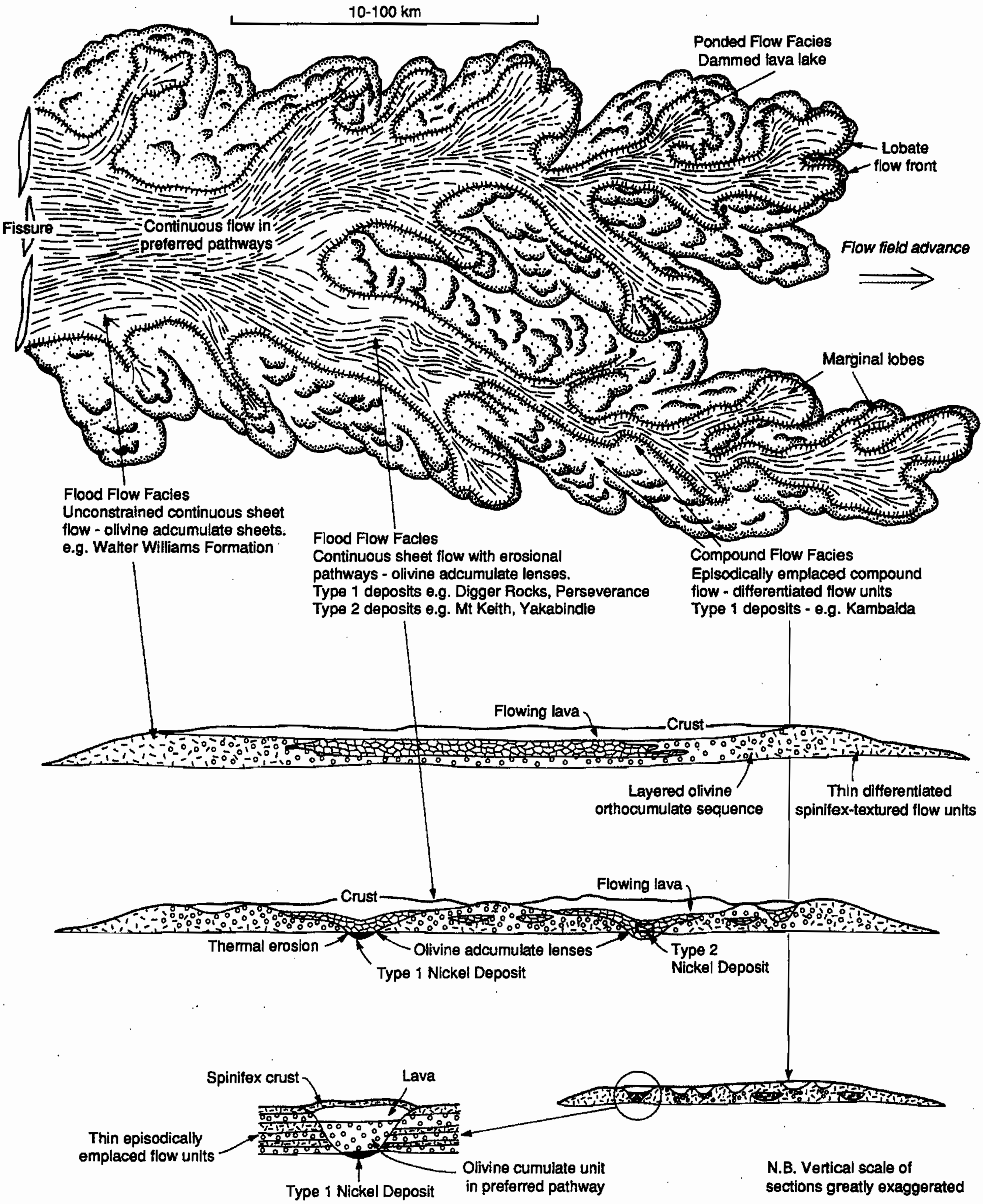


Figure 1.6 UPPER - Schematic lateral section through a regional inflationary komatiite flow field developing via sustained eruption of lava, portraying possible relationships between various volcanic facies, and depicting those eruptive environments (with examples) conducive to the formation of types 1 and 2 Ni deposits. (After Hill et al., 1995.)
LOWER - Vertical sections through the regional komatiite flow field, illustrationg the various volcanic facies depicting in the upper figure, showing lithological associations and the environments of accumulation of types 1 and 2 Ni deposits. (Dowling and Hill, AGSO Volume 17, 1998.)

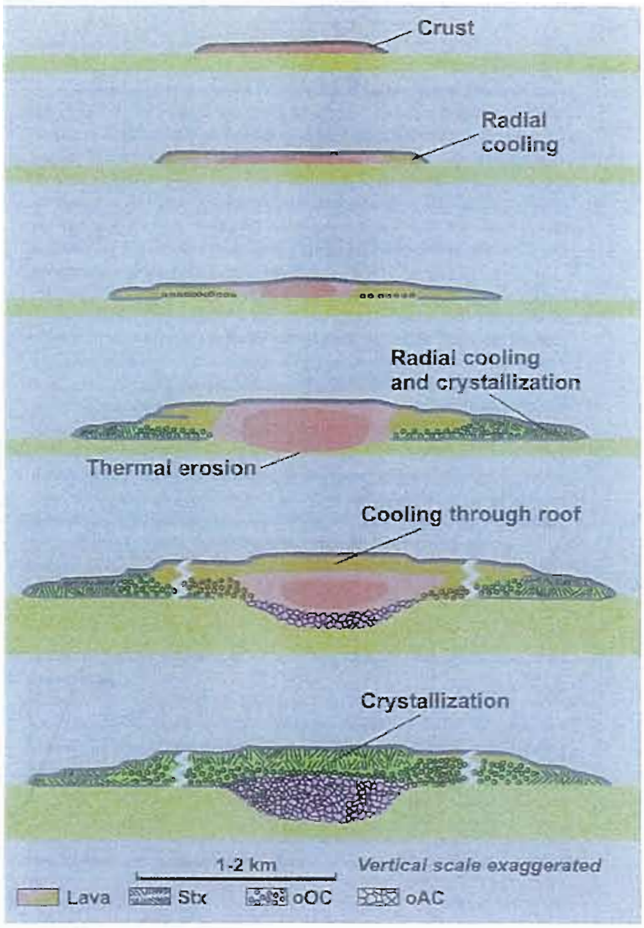


Figure 1.7 Continuous sheet flow with erosional pathways. (After Hill et al., 1995.)

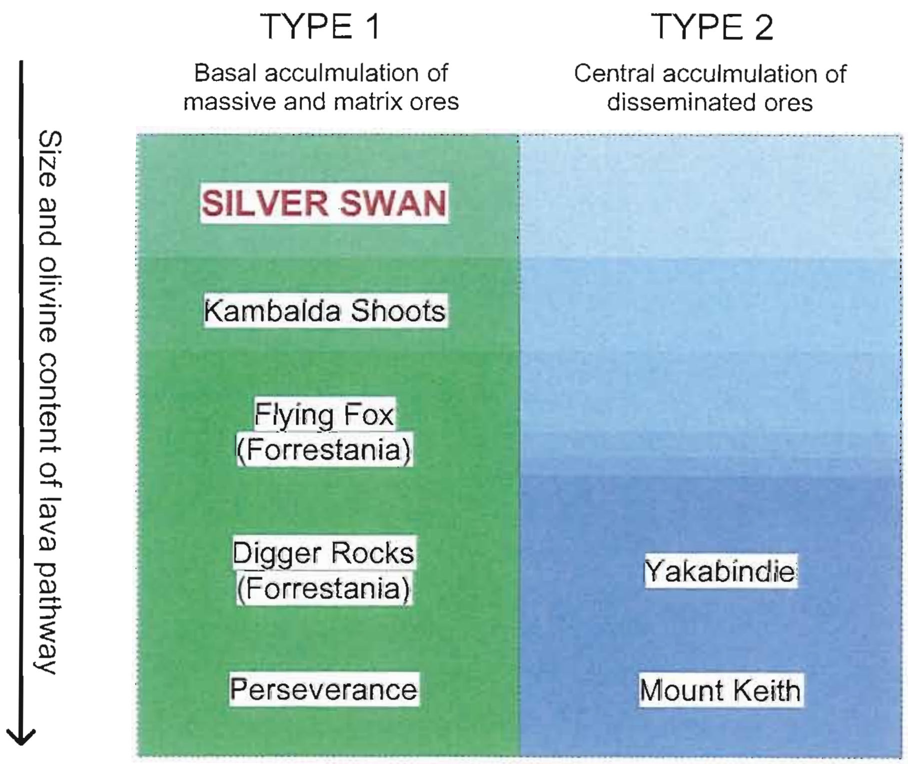


Figure 1.8 Classification matrix for komatiite-hosted Ni sulphide deposits. (After Hill et al. 1999.)

1.5 Genesis and Volcanological setting of Nickel Deposits

Hill & Gole (1990) and Lesher (1989) classified Komatiite-hosted nickel sulphide ore bodies into Type 1 or Type 2 ore bodies. This division was based on the nature of the Fe-Ni-Cu sulphide ore and its distribution relative to the Komatiite host (Hill, 1997).

Type 1 deposits comprised accumulations of massive and/or matrix ore at the base of preferred lava pathways in Komatiite flow fields. Type 2 deposits consisted of accumulations of disseminated sulphide in the central zones of large olivine cumulate bodies, which occupied preferred lava pathways. The classification is based on the mode of emplacement of the sulphide liquid (Barnes *et al.*, 1994; Hill *et al.*, 1996). A classification matrix for Komatiite-hosted nickel sulphide deposits illustrating the position of the Silver Swan deposit, is provided in Figure 1.8.

1.6 Geophysical Logging

Whereas geophysical logging has played a critical role in petroleum exploration and production, its overall impact on metalliferous exploration and mining has been minor.
The most common application of borehole logging in metalliferous mines is for defining the limits of mineralisation. The oldest application of this concept is the use of in-hole magnetic susceptibility to define ore limits in magnetite mines (Virkkunene & Hattula, 1992). Gamma-gamma logging was applied to determine tin boundaries and grade in Czechoslovakian mines in the 1960s (Simon, 1969). Petrophysical delineation of massive sulphide zones is usually feasible given their extreme electrical conductivity, high density, negligible gamma radiation, and often-high magnetic susceptibility.

The geophysical definition of mineralisation boundaries can be undertaken down either diamond or percussion holes. Huge savings can be made over the life of a mine, if a large proportion of holes are p ercussion drilled and g eophysically logged rather than diamond drilled (Fallon *et al.*, 1997). Geophysical logging techniques can also, in some instances, substitute for the detailed geochemical, structural and geotechnical analysis undertaken on selected core samples. Advantages of borehole geophysical logging include provision of:

- A 3-dimensional prospecting method by increasing the prospective search radius of each drillhole (Ogilvy, 1985).
- Information on the spatial distribution of intersected mineralisation away from the hole.
- Bulk sampling of mineralised units of interest, which are more representative than core alone, especially in geologically complex areas.
- Accurate definitions of in-situ electrical properties of host rock and mineralised units. This allows the possibility of using these measurements to estimate sulphide volume percentages or economic metal percentages (Tyne, 1987).
- Detection of mineralisation, which could be missed in areas of poor core recovery.
- Location of weakly mineralised or altered zones, not apparent in drill core, which may indicate larger mineral concentrations away from the hole.
- Lithological and structural correlations between boreholes. These can be used as mapping tools to aid in interpretation of geological settings, or in outlining the extent of a deposit.
- Information on engineering properties of a deposit and its host rocks to aid geotechnical studies.

In the Kambalda district, Western Mining Corporation Ltd use downhole and underground geophysical methods to address difficulties encountered in Komatiite-hosted nickel sulphide exploration (Trench & Williams, 1994). Such methods include:

- isolating the geophysical response of closely spaced ore lenses;
- discriminating the geophysical response of ore from the nearby country rock;
- evaluating the sub-surface and hole-to-hole continuity of ore shoots;
- elucidating sub-surface structure by determination of fault displacements; and,
- providing physical property information (typically magnetic susceptibility, natural gamma, apparent conductivity, and density) in order to correctly interpret surface geophysical responses.

1.6.1 OMS - LOGG

Outokumpu Oy in Finland recognised the potential of logging in the base-metal mining context and developed a logging system, OMS-LOGG, especially adapted for underground mining in the 1980's (Lappalainen & Lehto, 1995). OMS-LOGG is a proprietary but commercially available system.

1.7 Black Swan Project

The following chapters outline the evaluation of the Black Swan Project in terms of:

- reviews of the regional and local geology of the Black Swan Succession;
- an estimation of the petrophysical properties of rock facies (trough versus flank) within the Succession; and,
- an assessment of the relationship between the petrophysics and petrology and mineralogy of selected intervals within the Succession in an attempt to establish ore vectors.

CHAPTER TWO

Project Background

2.0 PROJECT BACKGROUND

The Black Swan Project area has had a long exploration history, with the region having been explored for various commodities including nickel, gold and diamonds.

During 1967, Australian Anglo American (AAA), as part of a joint venture with Whim Creek Consolidated NL and Freeport of Australia Incorporated, targeted the area for nickel sulphide mineralisation. Initial work comprised the use of aeromagnetic images to identify magnetic highs, which could represent ultramafic bodies hosting nickel sulphides. Soil sampling outlined a nickel copper geochemical anomaly. Further sampling and subsequent diamond drilling of this soil anomaly led to the discovery of the Black Swan disseminated nickel sulphide deposit in 1970. The deposit was calculated to have a geological resource of 3.5 million tonnes at 0.85% Ni. This was not considered economic.

Exploration continued in the area and during 1974, AAA drilled three diamond holes north of the Black Swan disseminated deposit, one of which intersected 17.9m of disseminated nickel mineralisation grading 2.17% Ni. However, due to a downturn in the mining industry, this promising intercept was not followed up.

In 1994, the Black Swan area was selected by Fodina Minerals Pty Ltd (a wholly owned subsidiary of Mining Project Investors (MPI)), in joint venture with Outokumpu Exploration Ventures Pty Ltd (OEV), as an exploration target on the basis of a disseminated sulphide intercept located north of Black Swan. The project was managed by MPI. In May 1995, diamond hole BSD 15, which was sited to follow up the anomalous AAA drill intercept north of Black Swan, intersected 2.45m of massive nickel sulphides grading 16.7% Ni.

The Silver Swan deposit was outlined by November 1995 and had an Indicated Mineral Resource of 440,000t at 14% nickel with minor associated copper, cobalt and arsenic mineralisation. Commercial production at Silver Swan began in April 1997, with future development proposed for Cygnet (Hicks & Balfe, 1998).

The MPI interest was sold in 1998 leaving Outokumpu as 100% owners. In August 2002 Outokumpu resold the mine to MPI. Total production since project commencement is 78,600 tonnes of nickel metal as at March 2002. Ore reserves calculated in December 2001 were at 350,000 tonnes of massive sulphide at 6.8% Ni and 190,000 tonnes of disseminated sulphide at 2.6% Ni.

2.1 Regional Geology

The Black Swan Project is located within the Norseman–Wiluna greenstone belt, in the Eastern Goldfields Province of the Archaean Yilgarn Craton (Figure 2.1). The greenstone belt extends for 900km, is 400km wide, and comprises both mafic and felsic volcano-sedimentary successions and intrusive rocks. The greenstone has been metamorphosed to greenschist to amphibolite facies grade. The successions were deposited between 2.7 and 2.69 Ga on a composite raft consisting of numerous fragments of sialic crust (Archibald *et al.*, 1981; Swager *et al.*, 1992; Myers, 1997).

The Eastern Goldfields Province has been separated into five major fault bounded terranes (Figure 2.2), which have been interpreted as representing contemporaneous basins (Myers, 1997). The Kalgoorlie Terrane is host to the Black Swan Succession. It is separated from adjacent terranes to the west by the Ida Fault, and to the east, is bounded by the Moriaty Shear – Mount Monger Fault system and Menzies Shear.

The stratigraphy of the Kalgoorlie Terrane consists of a lower basalt facies, then a Komatiite facies, overlain by an upper basalt facies, succeeded by an overlying felsic volcanic and volcaniclastic rocks, and finally an overlying polymictic conglomerate unit (Swager, 1997).

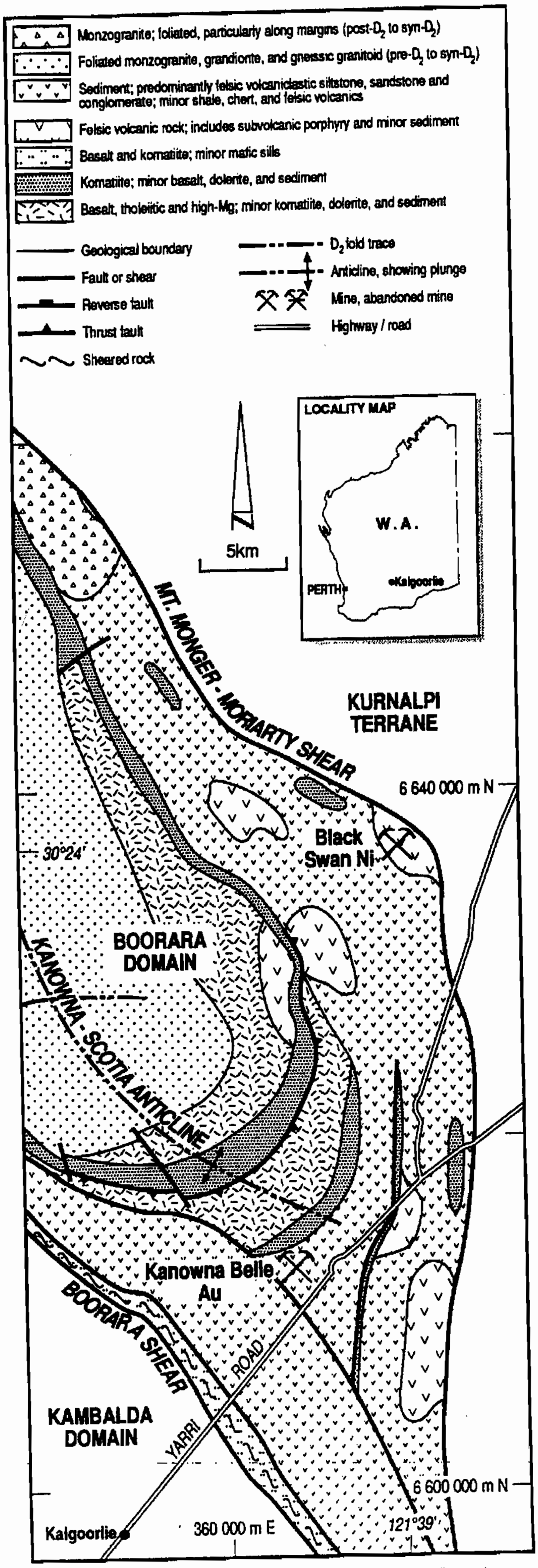


Figure 2.1 Location and regional geology, Boorara Domain. (After Swager and Griffin, 1990.)

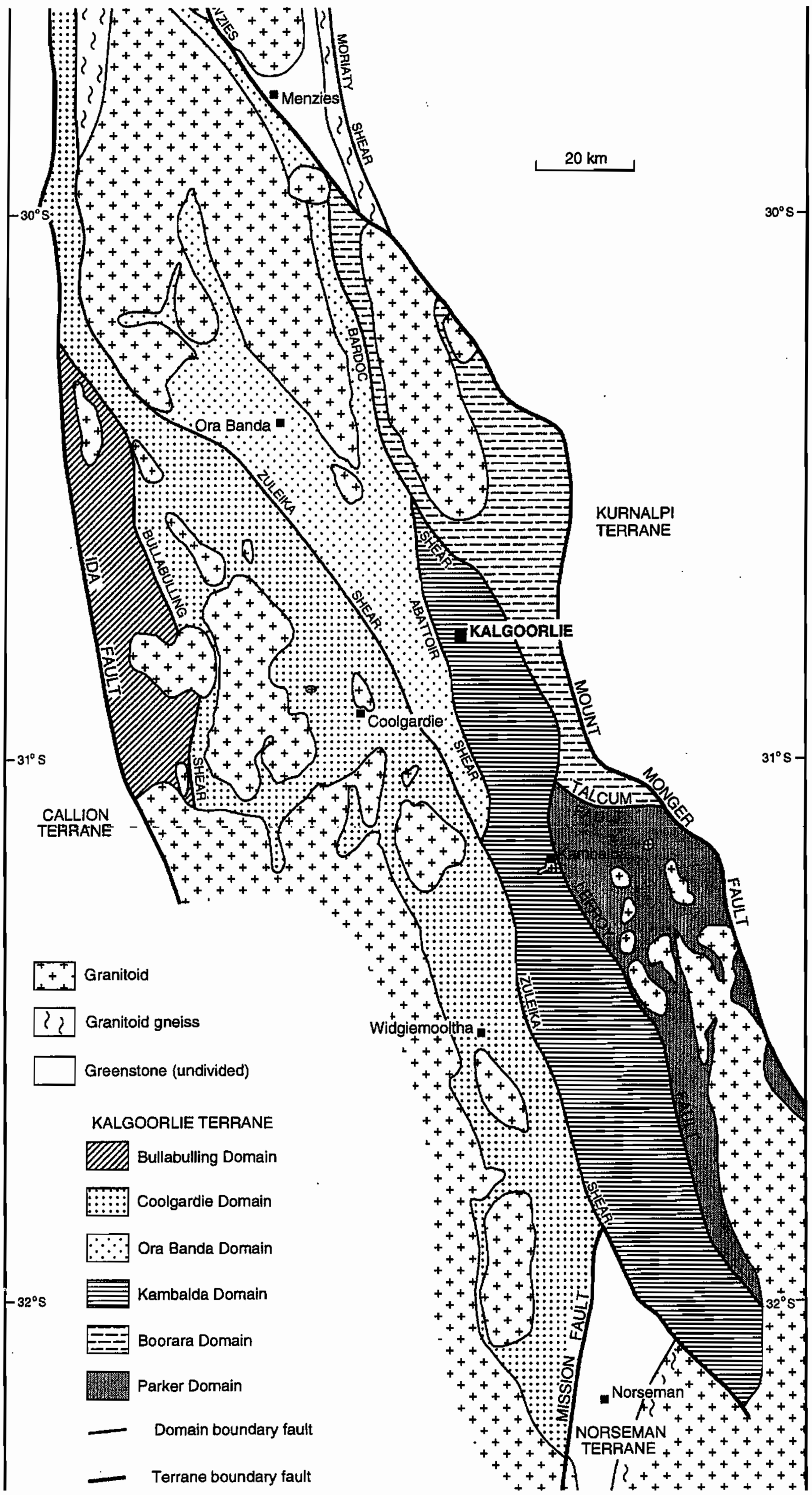


Figure 2.2 Terrane map of the Kalgoorlie region, highlighting the Kalgoorlie terrane and its six constituent tectonostratigraphic domains. Note revision of boundaries. (After Swager et al., 1995.)

Minor variations in regional stratigraphy and deformation history have led to the subdivision of the Kalgoorlie Terrane into six fault bounded tectonostratigraphic domains (Swager *et al.*, 1992; Swager *et al.*, 1995) (refer Table 2.1).

The Boorara Domain is host to the Black Swan Succession. The Mount Monger Shear to the east and the Boorara Shear to the west form the boundaries to the Boorara Domain. The Boorara Domain stratigraphy typically conforms to the general regional stratigraphy illustrated in Table 2.1, however it lacks an upper basaltic unit.

Table 2.1 Stratigraphics correlations for the Ora Banda, Kambalda, Coolgardie, and Boorara Domains of the Kalgoorlie Terrane (after Swager et al, 1995).

STRATIGRAPHIC SUCCESSION	CHARACTERISTIC LITHOLOGIES	ORA BANDA DOMAIN	KAMBALDA DOMAIN	COOLGARDIE DOMAIN	BOORARA DOMAIN
Polymictic conglomerate unit	Polmictic conglomerate immature sandstone: coarse trough cross beds. Graded beds	Kurrawang Formation	Merougil	Absent	Absent
Felsic volcanic and sedimentary unit	Felsic volcaniclastic – sedimentary rocks, ranging from coarse classic sandstone to interbedded sand/siltstone Rhyolite to dacite.locally andesite: lava, tuff, agglomerate	BLACK FLAG GROUP Pipeline Andesite Orinda Sill Ora Banda Sill	BLACK FLAG GROUP Junction Dolerite Condenser Dolerite Golden Mile Dolerite Triumph Gabbro	BLACK FLAG GROUP White Flag Formation Powder Sill Spargoville Formation	Felsic Unit, volcanic and sedimentary rocks Black Swan
Upper basalt unit	High-Mg and tholeiitic basalt; massive, pillowed and vesicular lavas	GRANTS PATCH GROUP Victorious Basalt Bent Tree Basalt Mt Pleasant Sill Mt Ellis Sill	KALGOORLIE GROUP Paringa Basalt Defiance Dolerite Williamstown Dolerite Kapi State	COOLGARDIE GROUP Absent or thin and discontinuous	Absent or thin and discontinuous
Komatiite	High-Mg basalt at top: thin komatiite flows with minor interflow sedimentary beds, overlaying thicker komatiite flows and/or massive olivine adcumulate	LINGER AND DIE GROUP Big Dick Basalt Siberia Komatiite Walter Williams Formation	Devon Consols Basalt Kambalda Komatiite <u>Kambalda nickel sulphide deposits</u>	Hampton Formation	Highway Ultramafics Big Blow Chert
Lower basalt unit	Tholeiitic and high-Mg basalt flows, subaqueous	POLE GROUP Missouri Basalt Wongi Basalt	Lunnon Basalt	Golden Bar sill Burbanks Formation Three Mile Sill	Scotia Basalt
References		Witt (1987, 1994)	Roberts (1988) Woodall (1965) Langsford (1989) Cowden and Archibald (in prep.)	Hunter (1993)	Christie (1975) Witt (1994)

The Black Swan Succession is developed within the Boorara Domain of Swager *et al.* (1992). Within the Domain, the basal unit is the Scotia Basalt, which displays a change in volcanic character from high-Mg to tholeiitic basalt composition and is believed to have formed from asthenospheric mantle melts (Nest & Sun, 1976; Swager *et al.*, 1992). The Highway Ultramafic, a sequence of Komatiite flows, overlies the Scotia Basalt. Fine-grained interflow sulphidic grey shales and cherts occur in both the mafic and ultramafic units. A volcano-sedimentary rock succession overlies the Highway Ultramafic, and is dominated by subaqueous dacitic-rhyolitic lava flows, subaqueous to subaerial andesitic tuffs, and agglomerates (Swager *et al.*, 1992; Swager, 1997). The Black Swan Succession is one of several lava flows of basaltic to ultramafic composition intercalated in this predominantly alkaline package.

The Black Swan Succession comprises:

- a footwall felsic volcanic unit consisting of a felsic porphyry and a felsic debris flow breccia;
- an internal felsic volcanic sequence consisting of several debris flows and an intrusive porphyry, deposited contemporaneously with Komatiite volcanism; and,
- a hanging wall ultramafic volcanic package, represented by minor rapid, turbulent lava flows.

The Komatiite flows have a strike length of at least 3km and attain a maximum thickness of 600m (Turnbull, 1997). The Komatiite has been subjected to intense carbonation, which has altered the primary volcanic assemblage to a carbonate-talc±quartz-sericite assemblage (Hill *et al*, 1999).

2.1.1 Structure

The regional deformation history involves early D1 recumbent folding and thrusting followed by a transcompressional regime with large-scale, upright D2 folding. Following this was a period of transcurrent D3 faulting with associated en-echelon folding and granitoid emplacement. The final deformation resulted in continued regional D4 shortening (Swager, 1989; Swager & Griffin, 1990a; Swager *et al.*, 1990). Upper greenschist to lower amphibolite facies metamorphism is dominant in the Boorara Domain, with extensive carbonation and hydration occurring along major fault systems (Swager *et al.*, 1995).

2.1.2 Metamorphism

The metamorphic grade of the Boorara Domain has been constrained to be within the upper greenschist to lower amphibolite facies (Binns *et al.*, 1976; Griffin, 1990a; Swager *et al.*, 1990; Witt *in prep.*). Regional metamorphism is characterised by low to intermediate pressures and reached peak temperatures late during D2-D3 transcompressional deformation, contemporaneously with syn-D3 granitoid emplacement (Swager *et al.*, 1990). Extensive carbonation and hydration occurred along and adjacent to major fault systems and continued during regional metamorphism (Swager *et al.*, 1990). Gold mineralisation in the region is broadly contemporaneous with peak regional metamorphism, and associated alteration assemblages correlate broadly with regional metamorphic grade (Swager *et al.*, 1990).

The greenstones in the Kalgoorlie Terrane were emplaced around 2.7 Ga with the main period of deformation (McNaughton & Dahl, 1987; Browning *et al.*, 1987; Barley & McNaughton, 1988; Foster *et al.*, 1996), granite intrusion, metamorphism, and epigenetic gold mineralisation between 2.66 and 2.64 Ga (Swager *et al.*, 1990).

2.2 Geology of the BSS

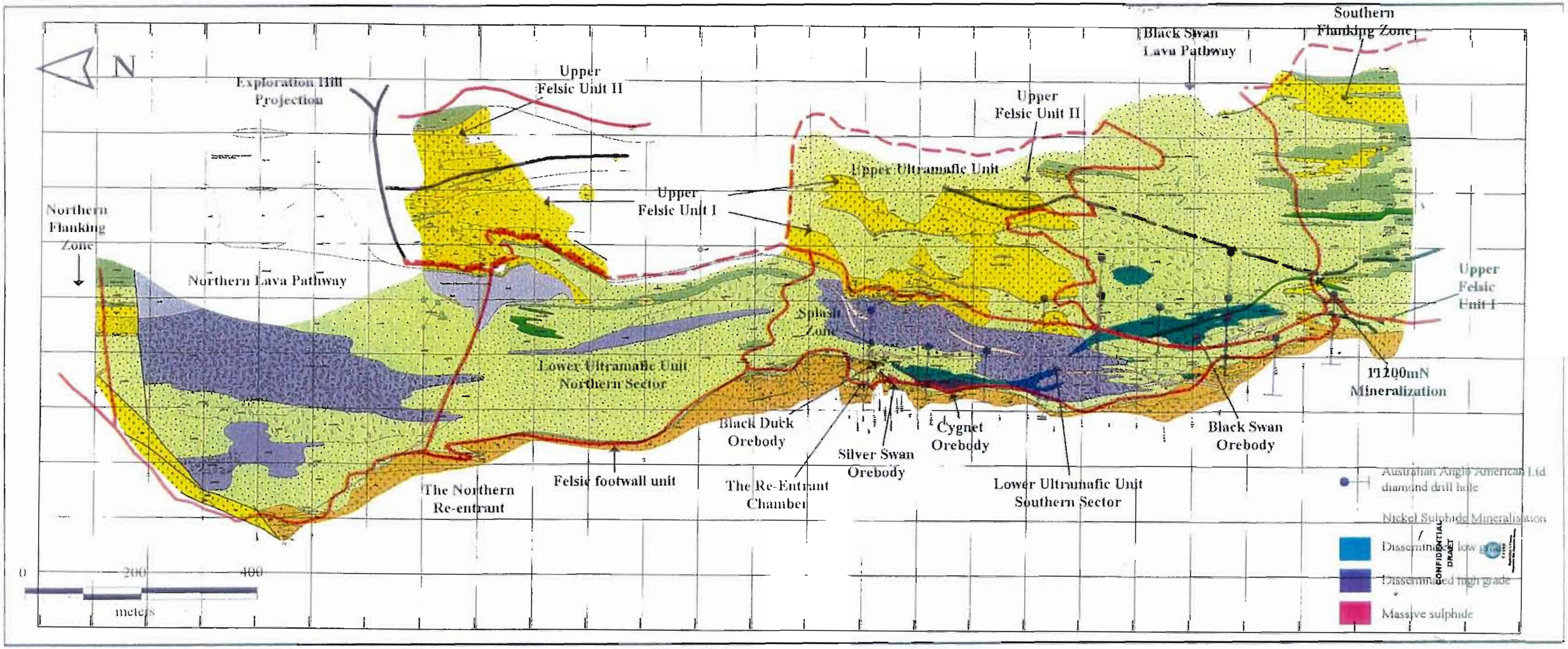
The Black Swan Succession (BSS) is a poorly exposed, NNW-trending, variable to steeply easterly-dipping body of predominantly talc-carbonate rock with minor serpentinite. The Komatiite lava is interpreted to have erupted onto a substrate consisting of coherent and brecciated dacitic lavas (McPhee, 1998; Turnbull, 1997). The BSS is between 150-600m wide and has a strike length of approximately 3km. Weathering depths varied from approximately 40m over the felsic footwall rocks, to over 200m in localised shoots within the BSS (Amann & Pietila, 1998).

The Black Swan Succession is a sequence of coeval komatiitic and felsic volcanic rocks. Hill *et al.* (1999) defined a total of nine lithostratigraphic units and volcanic zones within the BSS. Figure 2.3 is an outcrop plan of the Black Swan Project, and shows the interpreted boundary of the ultramafic unit as defined by Mining Project Investors Pty Ltd. Figure 2.4 is an annotated level plan taken from Hill *et al.* (1999) overlain by the by the nine zones (figure 2.5, refer to Appendix 2 for legend). The plan that was compiled from diamond drillhole and outcrop geology and depicts the geological relationships between the various subunits identified by Hill *et al.* (1999).

Hill *et al.* (1999) interpret the northern Lava Pathway to represent a long-lived lava pathway that is now infilled by a variety of barren olivine cumulates.

Lower Ultramafic Unit, is subdivided by Hill *et al.* (1999) into the Southern and Northern Sector. The Southern Sector hosts the known massive sulphide deposits except for 11,200mN and overlies the Felsic Footwall unit with the basal contact being erosional in nature. This Sector is characterised by an upper section dominated by bimodal textured olivine orthocumulates/mesocumulates and internal sago and harrisitic olivine cumulates. The lower section consists of a thin complex zone of hybrid melts and contaminated platy olivine cumulates. Laterally restricted thin contaminated olivine and pyroxene spinifex-textured flows are also present (Hill *et al.*, 1999). The Southern sector is interpreted by Hill *et al.* (1999) to represent a network of olivine filled overlapping lava tubes and breached lava pathways. The Northern Sector consists mainly of barren olivine orthocumulates/mesocumulates.

Figure 2.4 Black Swan Lava Pathways



projects\BlackSwan\Drilling\LevelPlans\BS_CSIRO_MagOreDep_1135d_overlay7k, 12/10/2000, BSCG

Modified from Hill et al, 1999

Figure 2a

Figure 2.5

CSIRO annotated level plan of the Black Swan Succession

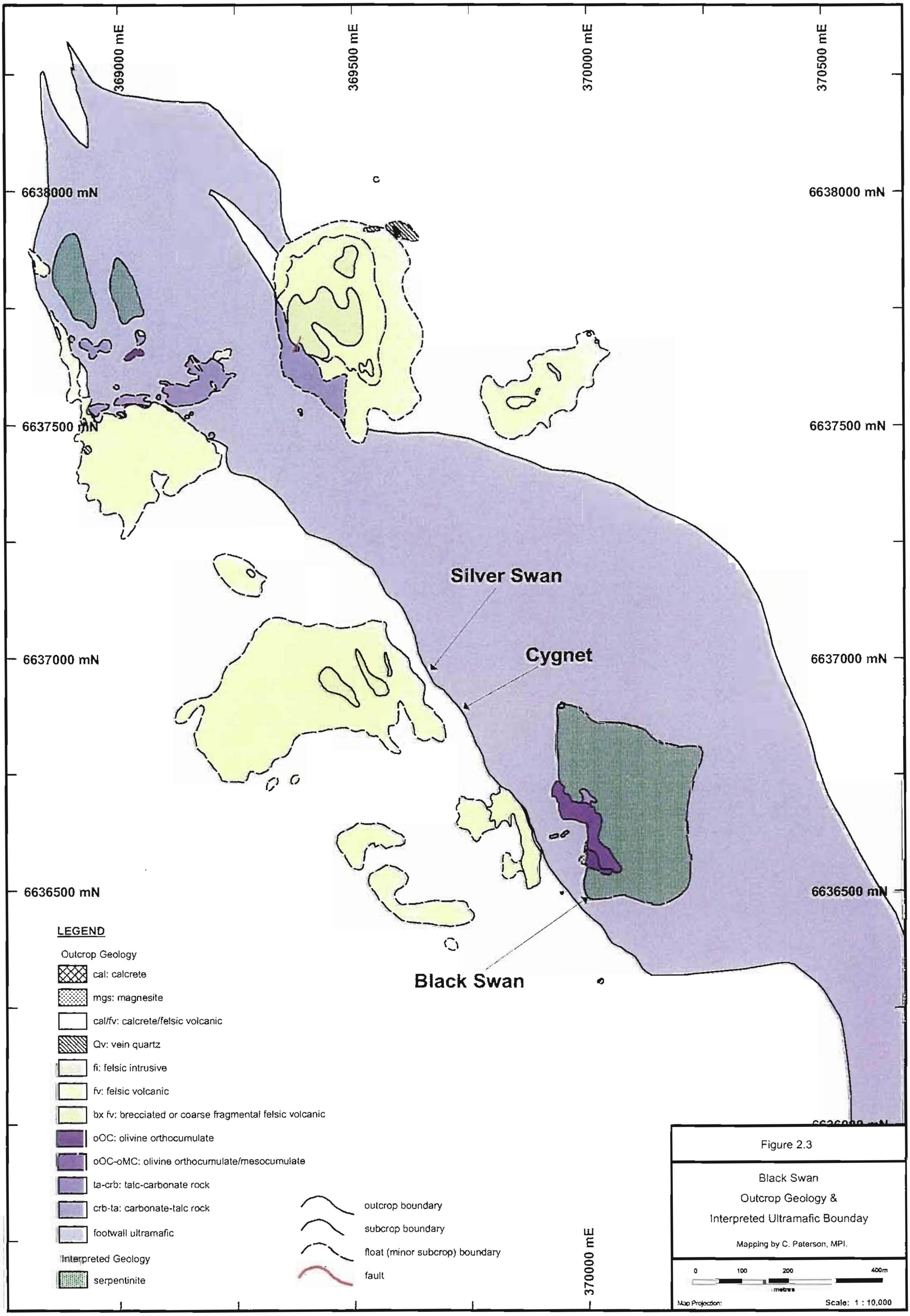


Figure 2.3

Black Swan
Outcrop Geology &
Interpreted Ultramafic Bounday

Mapping by C. Paterson, MPI.

The Upper Ultramafic Unit is situated on the northern flank of the Black Swan Lava Pathway and overlies the Lower Ultramafic Unit (Hill *et al.*, 1999). The Unit primarily consists of up to 60m thick individual flow units and a minority of compound flows, largely composed of olivine cumulate (Hill *et al.*, 1990). The Unit interdigitates with coeval felsic volcanic flows of the Upper Felsic Units I and II (Hill *et al.*, 1999).

The Black Swan Lava Pathway is located near the southern end of the Black Swan Succession and is described by Hill *et al.* (1999) as a lava conduit, 340m by >450m thick, infilled with a variety of medium- to coarse-grained olivine cumulates displaying a variety of textures including bimodal, hopper, platy, harrisitic, and equigranular textures (Hill *et al.*, 1999). The Black Swan Lava Pathway is host to the Black Swan disseminated sulphide orebody.

The Southern Flanking Zone is located at the southern boundary of the Black Swan Succession and consists of a series of coeval felsic and ultramafic lavas composed of a series of thin (2-20m) predominantly olivine spinifex textured flows and minor pyroxene-spinifex textured flows, which intersperse with felsic fragmentals (Hill *et al.*, 1999).

The Felsic Footwall Unit is comprised of plagioclase dacite lithologies and forms the undulating base of the Black Swan Succession (Hill *et al.*, 1999). Monomictic volcaniclastic lithic breccias dominate the sequence and are found in close connection with coherent lava intervals (Hill *et al.*, 1999). Hill *et al.* (1999) suggests the lithofacies association is coherent lava, containing thin autoclastic horizons, enveloped by welded breccia.

Upper Felsic Unit I and Upper Felsic Unit II occur stratigraphically higher in the sequence and are dominated by plagioclase-quartz dacite lithologies. They overlie the Lower Ultramafic Unit and are intercalated with the Upper Ultramafic Unit. The Upper

Felsic Unit 1 consists predominantly of autoclastic facies megacrystic plagioclase-quartz dacite lithologies and lies conformably on the Lower Ultramafic Unit. The Upper Felsic Unit II caps Unit 1 and in contrast is devoid of feldspar megacrysts (Hill *et al.*, 1999).

2.2.1 Metamorphism

Regional CO_2 infiltration is a common feature in the Eastern Goldfields terrains of the Yilgarn Block, where it is intimately associated with gold mineralisation (Groves *et al.*, 1989). The CO_2 incursion has resulted in a very widespread transformation of Komatiites in the Eastern Goldfields to talc-carbonate rocks, including within the Black Swan Project.

The dominant influence on the present mineralogy and texture of the BSS is the regional metamorphic event, characterised by higher temperature, commonly greenschist- to amphibolite-facies, dynamic metamorphism in the presence of CO_2-bearing fluids. Progressive serpentinisation and carbonation of the BSS resulted. The minerals present are talc, carbonate (magnesite and dolomite), chlorite, quartz and serpentine (lizardite and antigorite).

The Black Swan metamorphic conditions are plotted on Figure 2.6. At pressures between 2-4KB, the peak metamorphic temperature has been constrained to between 300-350^{0}C (Hill *et al.*, 1999). Figure 2.7 is an enlargement of the phase relations in the lower left hand corner of Figure 2.6 showing the stable mineralogical assemblages as functions of temperature and CO_2 content of the metamorphic fluid.

2.2.2 Mineralogy

The present mineralogy of the succession represents the metamorphic history and not necessarily the primary mineralogy of the rock units. This in turn is influenced by pressure / temperature conditions, original bulk composition and fluid rock ratio. In these

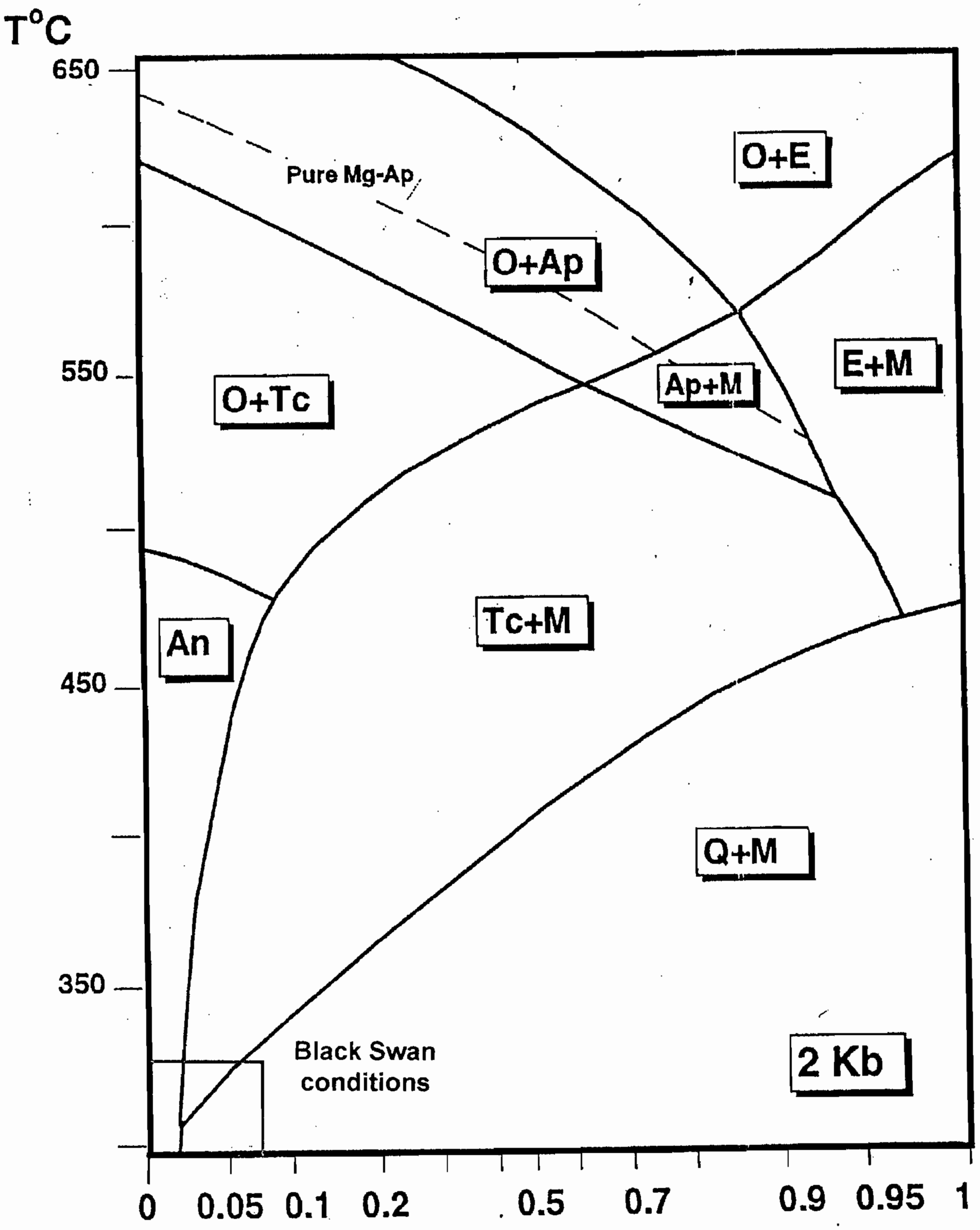


Figure 2.6 T-XCO2 phase diagram for olivine rich ultramafic assemblages in the presence of vapour at 2 KB total pressure. (After Barnes and Hill, 1999.) Abbreviations for phases: Tr=tremolite, Tc=talc, Ap=anthophillite, E=enstatite, Ag=antigorite, O=olivine, M=magnesite, B=bucite, Do=dolomite, D=diopside, Cb=carbonate (magnesite and/or dolomite), Q=quartz. (After Hill et al., 1999.)

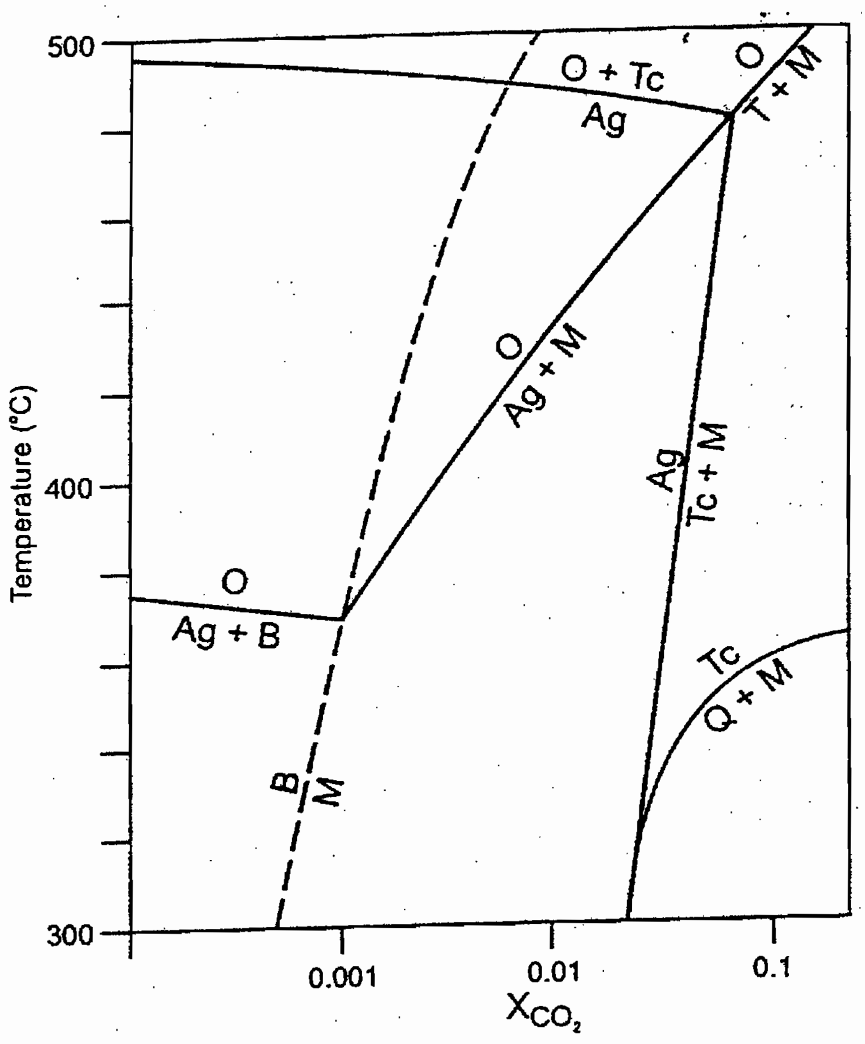


Figure 2.7 T-Xco² phase diagrams for ultramafic assemblages at low T and Xco² modified from Johannes (1969) and Will et al. (1990) as published in Barnes and Hill (1999). Position of olivine-brucite-antigorite-magnesite invariant point from unpublished calculations by Powell (Hill et al. 1999). Stability fields for lizardite and chrysolite not shown due to lack of experimental calibration. Abbreviations for phases: Tr=tremolite, Tc=talc, Ap=anthophillite, E=enstatite, Ag=antigorite, O=olivine, M=magnesite, B=bucite, Do=dolomite, D=diopside, Cb=carbonate (magnesite and/or dolomite), Q=quartz.

altered terrains trying to marry the physical properties to original rock type is extremely difficult.

The Black Swan Succession can be broadly divided into four main rock types, quartz-chlorite, quartz carbonate, serpentinite and talc-carbonate, which exhibit relict spinifex and cumulate textures. These rocks are poorly exposed and where outcropping consist of weathered silicified massive serpentinite exhibiting relic cumulate textures. Fresh olivine is almost completely absent.

Table 2.2 describes the typical assemblages seen within the Black Swan Succession during the course of this study.

TABLE 2.2 Mineral assemblages found within the Black Swan Succession

Protolith	Protolith Mineralogy	Serpentinisation	Carbonate Alteration
OSTX	Olivine blades-clinopyroxene-± chromite and glass	Chlorite-antigorite-magnetite after spinifex olivine. Chlorite-tremolite/actinolite ± relict pyroxene, spinel in groundmass	Chlorite-quartz-carbonate (mainly dolomite) ± talc ± dusty magnetite or haematite (refer to Figures 2.8a & 2.8b)
PXSTX	Pyroxene + liquid	Temolite-chlorite	
OOC	Olivine ± chromite + liquid	Antigorite-chlorite-magnetite after olivine, chlorite-tremolite/actinolite groundmass	Carbonate(magnesite-dolomite) -quartz – chlorite + haematite + chromite + magnetite (refer to Figures 2.8c, 2.8d & 2.8e)
OMC	Olivine ± chromite + liquid	Antigorite-brucite serpentine + chlorite + magnetite veining Lizardite-olivine-chlorite + chromite + magnetite Serpentine-tremolite-chlorite-brucite	Talc-carbonate ± quartz Talc-magnesite-dolomite-chlorite-haematite ± quartz ± magnetite ± chromite Carbonate(magnesite)-quartz-chlorite (Refer to Figures 2.8f, 2.8g & 2.8h)

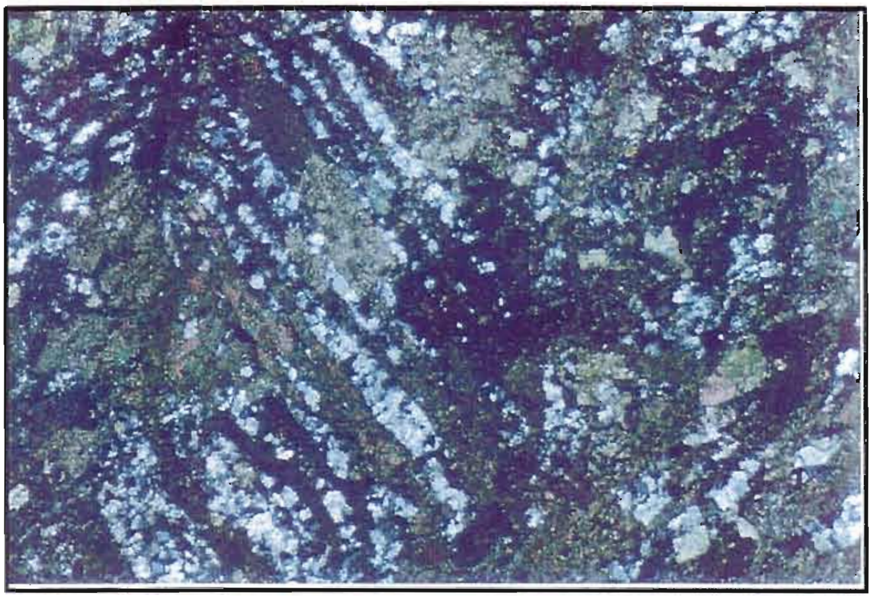


Figure 2.8a Photomicrograph in transmitted light, crossed polars. Field of view is approximately 2.75mm. Sample is from hole BSD 86 at depth 209.53m within the southern flanking zone of the Black Swan Succession carbonate-chlorite-quartz rock after spinifex textured komatiite.

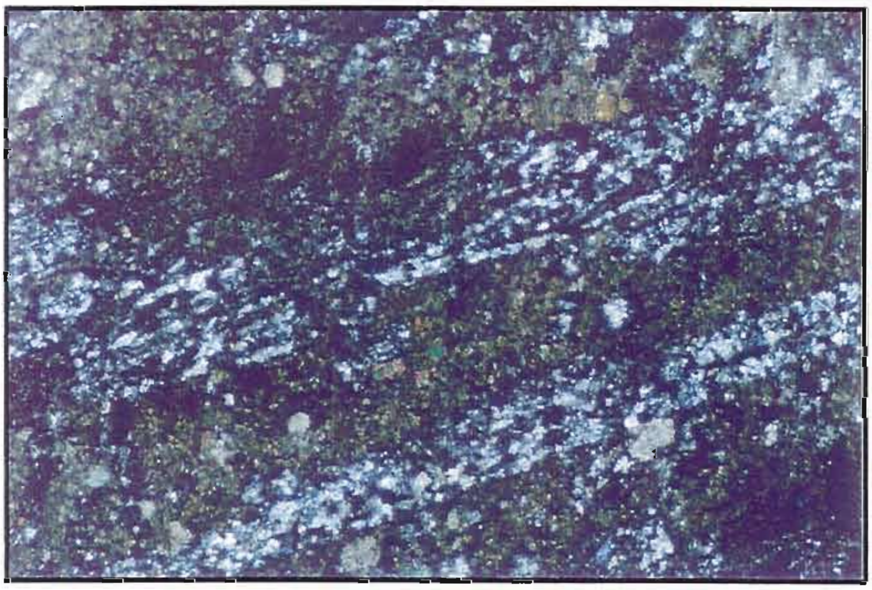


Figure 2.8b Photomicrograph in transmitted light, crossed polars. Field of view is approximately 2.75mm. Sample is from hole BSD 86 at depth 209.53m within the southern flanking zone of the Black Swan Succession carbonate-chlorite-quartz rock after spinifex textured komatiite.

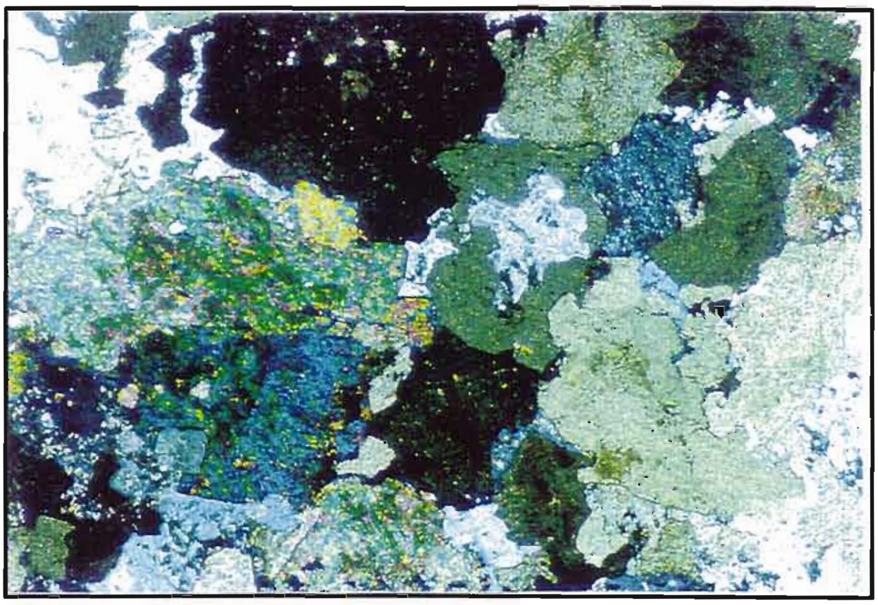


Figure 2.8c Photomicrograph in transmitted light, crossed polars. Field of view is approximately 2.75mm. Sample is from hole BSD 44 at depth 301m within the lower ultramafic unit, southern sector of the Black Swan Succession. Carbonate-quartz-talc rock after olivine cumulate.

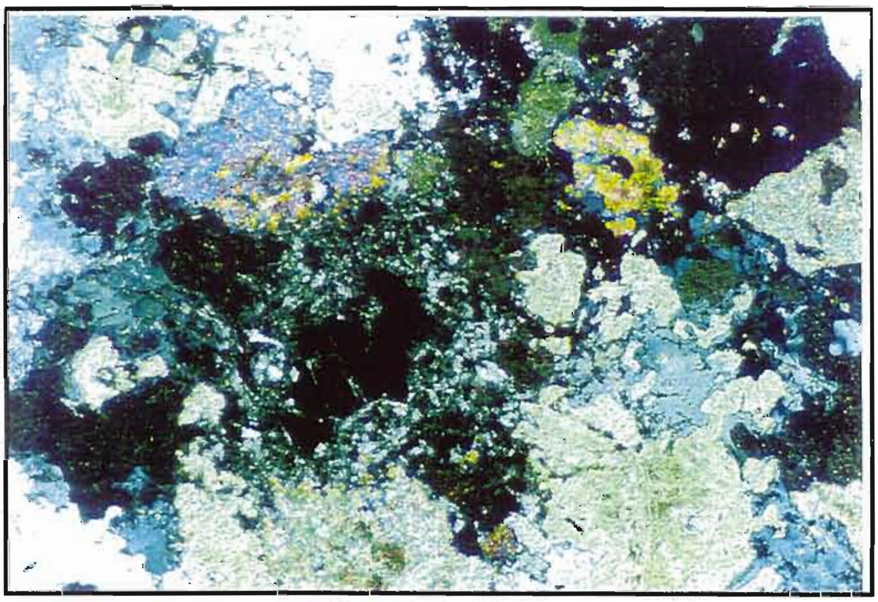


Figure 2.8d Photomicrograph in transmitted light, crossed polars. Field of view is approximately 2.75mm. Sample is from hole BSD 44 at depth 301m within the lower ultramafic unit, southern sector of the Black Swan Succession. Carbonate-quartz-talc rock after olivine cumulate. Note lobate chromite in center of view and dusty magnetite within porphyroblastic carbonate.

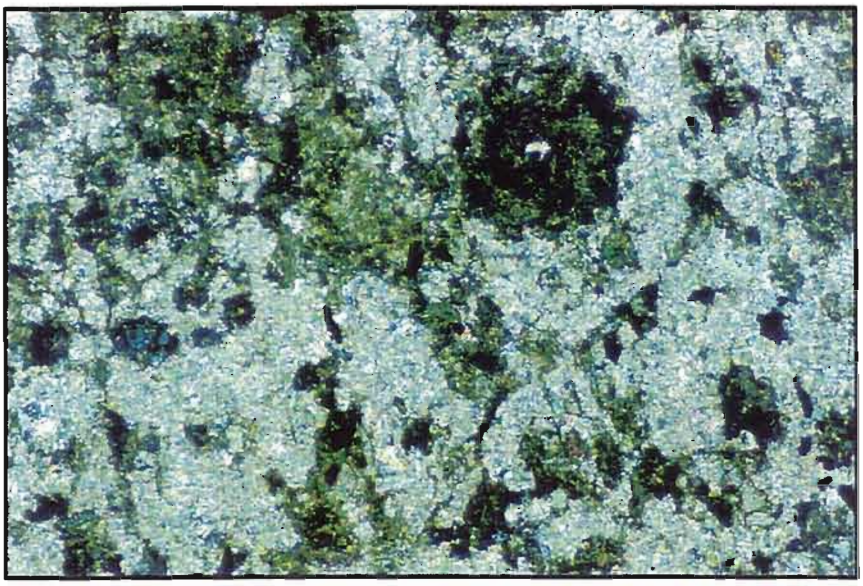


Figure 2.8e Photomicrograph in transmitted light, crossed polars. Field of view is approximately 4mm. Sample is from hole BSD 44 at depth 227m within the lower ultramafic unit, southern sector of the Black Swan Succession. Talc-carbonate-chlorite rock after olivine orthocumulate.

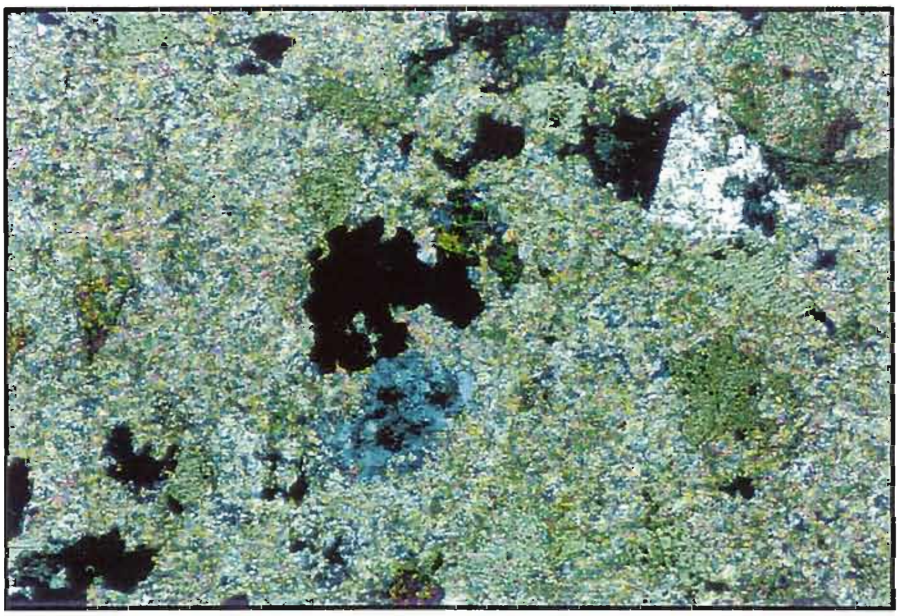


Figure 2.8f Photomicrograph in transmitted light, crossed polars. Field of view is approximately 4mm. Sample is from hole BSD 44 at depth 227m within the lower ultramafic unit, southern sector of the Black Swan Succession. Talc-carbonate-quartz rock after olivine mesocumulate.

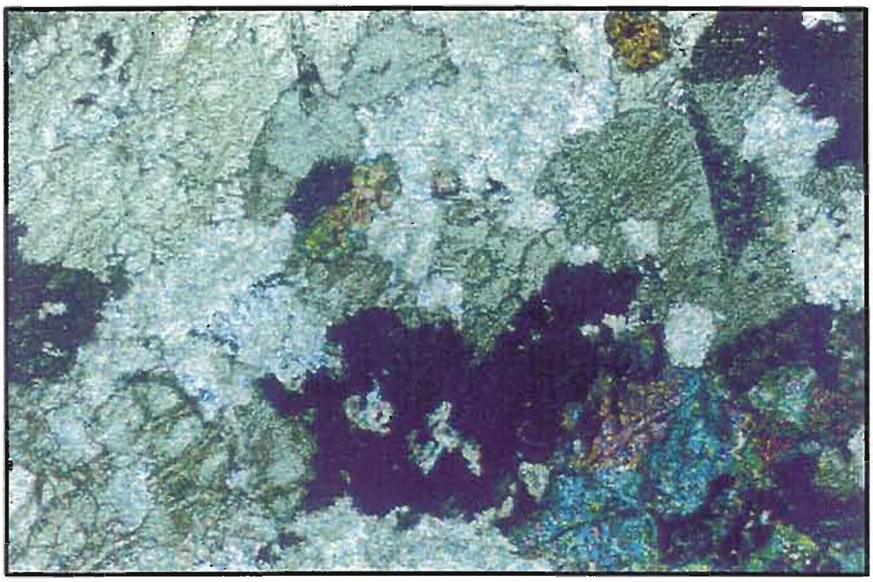


Figure 2.8g Photomicrograph in transmitted light, crossed polars. Field of view is approximately 2.75mm. Sample is from hole BSD 44 at depth 333m within the lower ultramafic unit, southern sector of the Black Swan succession. Talc-carbonate-sulphidic rock after olivine sulphide cumulate.

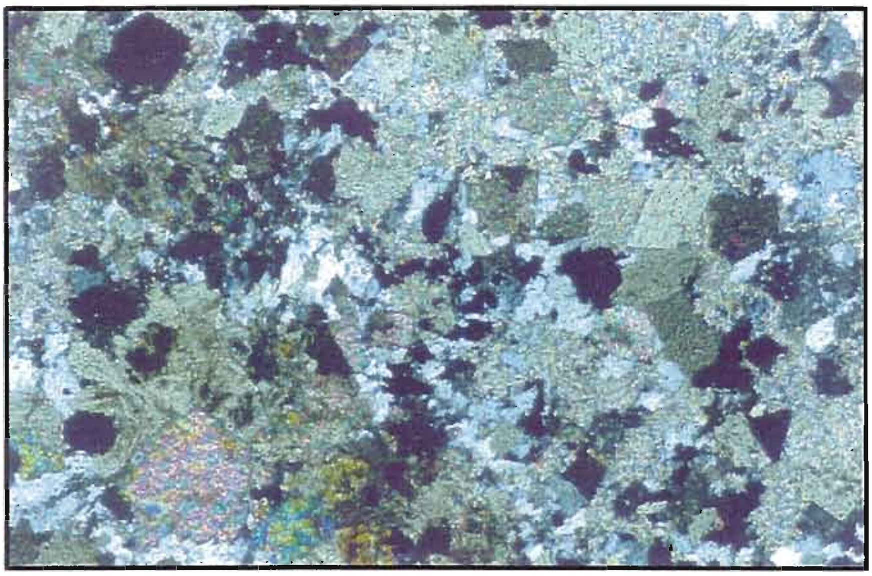


Figure 2.8h Photomicrograph in transmitted light, crossed polars. Field of view is approximately 4mm. Sample is from hole BSD 44 at depth 233m within the lower ultramafic unit, southern sector of the Black Swan succession. Talc-quartz-carbonate rock. Note abundance of dark larger magnetite grains and finer grained aggregates.

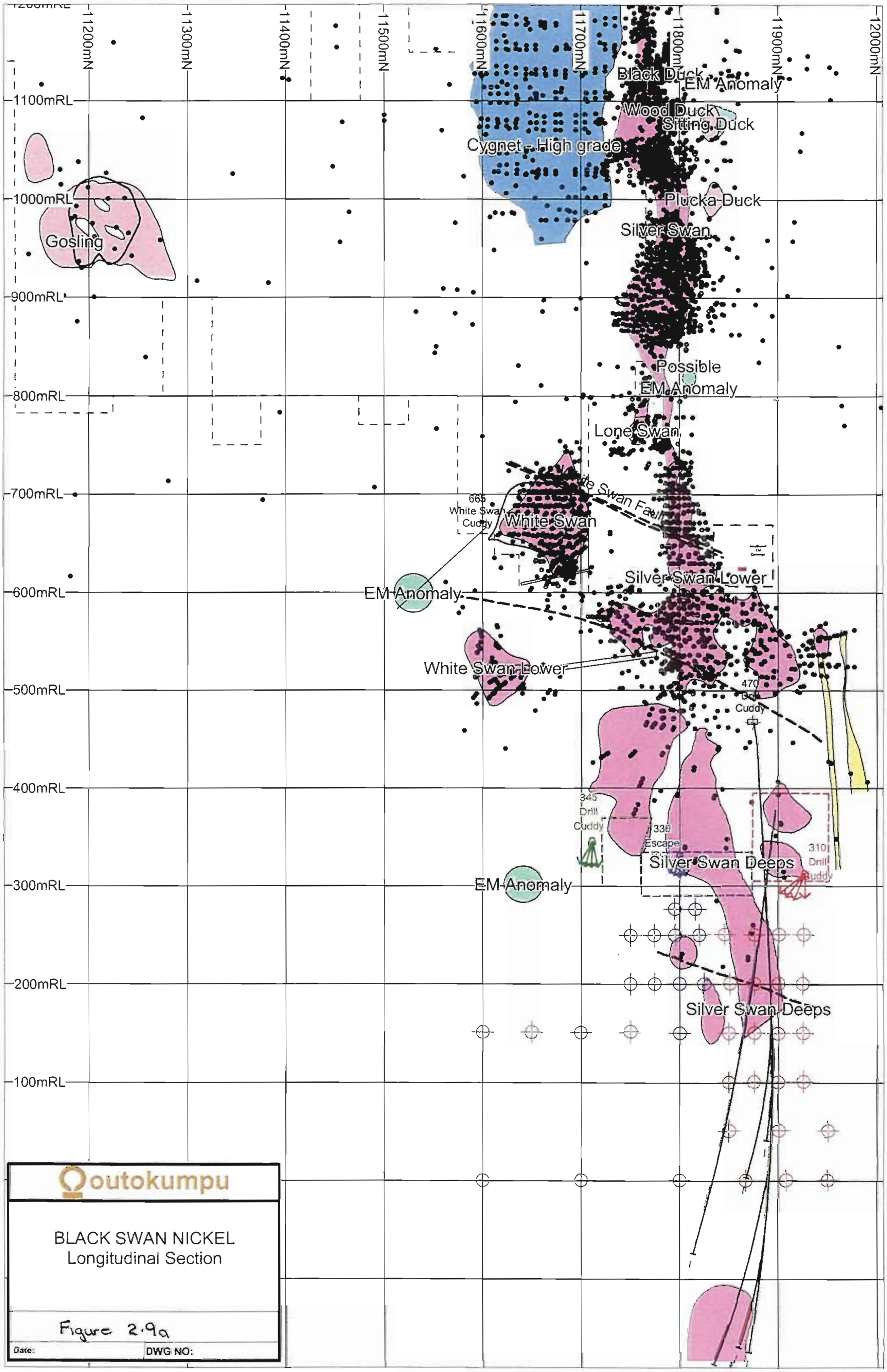
2.3 Orebodies and Mineralisation

The B lack Swan S uccession h osts t he S ilver S wan, Black D uck, W ood D uck, Silver Swan Deeps, White Swan, Cygnet, 11200mn, and Black Swan magmatic nickel sulphide orebodies. Refer to the Black Swan longitudal (Figure 2.9a) for location of the orebodies.

The basal contact of the Lower Ultramafic Unit with the Felsic Footwall Unit is host to the **Silver Swan ore body**. Inclusions and plumes of felsic footwall lithologies (Hill *et al.*, 1999) typified the lower contact with the felsic footwall. The deposit had a Mineable Reserve of 640,000t @ 9.5% Ni at commencement of mining. The Silver Swan mineralisation comprised a discrete shoot of massive sulphides dominated by a lattice or lace textured alternating bands of pyrrhotite and pentlandite with minor amounts of violarite (Ni_2FeS_4), chalcopyrite, pyrite, magnetite, chromite and gersdorffite (NiAsS). The ore body dips between 45° and 75° east, is 5-20m wide, and has a strike length of 75 metres. A small sinistral fault cuts the upper zone dislocating the massive sulphide into two separate shapes. Sporadic nickeliferous sulphide disseminations and sulphide filled veinlets and fractures often persist for several metres into the felsic substrate below the deposit (Goode, 2002).

The **Silver Swan Deeps Orebody** is the downdip continuation of the Silver Swan ore body and consists of massive sulphides located on and within the Footwall Felsic Unit. It forms a convex lensoidal tongue of massive pentlandite-pyrrhotite-pyrite mineralisation (Hill *et al.*, 1999), up to 50m wide and to 10m thick, extending for 300m down plunge. An ophitic- textured vertical intermediate/mafic dyke cuts the orebody into two separate panels. Some remobilisation of the massive pentlandite-pyrrhotite mineralisation about the dyke is evident.

The **Black Swan disseminated orebody** lies 400m to the south of Silver Swan and is hosted by serpentinite in the Black Swan Lava Pathway. As a result of research for a



11200mN
11300mN
11400mN
11500mN
11600mN
11700mN
11800mN
11900mN
12000mN
1100mRL
1000mRL
900mRL
800mRL
700mRL
600mRL
500mRL
400mRL
300mRL
200mRL
100mRL
Black Duck
EM Anomaly
Wood Duck
Sitting Duck
Cygnet - High grade
Plucka Duck
Silver Swan
Gosling
Possible
EM Anomaly
Lone Swan
White Swan Fault
665
White Swan
Cuddy
White Swan
Silver Swan Lower
EM Anomaly
White Swan Lower
470
Cuddy
345
Drill
Cuddy
335
Escape
310
Drill
Cuddy
Silver Swan Deeps
EM Anomaly
Silver Swan Deeps
outokumpu
BLACK SWAN NICKEL
Longitudinal Section
Figure 2.9a
Date:
DWG NO:

BSc (Hons) thesis, Hack (1972) and Hack *et al.* (1974), identified an unusual mineral assemblage of millerite (NiS-pyrite-magnetite-violarite (Ni_2FeS_4)) at Black Swan, with the previously unrecorded assemblage pyrite-vaesite-violarite. This finding led to a further study by Groves *et al.* (1974) into the modification of iron-nickel sulphides during serpentinisation and talc-carbonate alteration. They concluded that the ultramafic had undergone a complex history of serpentinisation, carbonation, talc-carbonation, and antigorite recrystallisation, with an accompanying progressive reduction in the amount of nickel fixed in silicate phases. Continued re-equilibration of the sulphide assemblage occurred after final recrystallisation of silicate carbonate phases, producing the unusual sulphide minerals. The Black Swan deposit has an Indicated Resource of 7 MT @ 0.8% Ni. The deposit lies within a zone approximately 300m long, up to 150m thick and situated 30-80 metres above the basal contact of the Black Swan Komatiite. The deposit has a steep easterly dip and steep northerly plunge.

The White Swan massive sulphide ore body lies in the Lower Ultramafic Unit, Southern Sector, in direct contact with the Footwall Felsic Unit. The orebody is lensoidal in form with a diameter of 70m and a thickness of 5m. The sulphide assemblage consists of pyrrhotite, pentlandite and pyrite.

Cygnet is a steeply plunging disseminated magmatic nickel sulphide orebody, which is positioned 5-10m stratigraphically above the basal contact of the Southern Sector of the Lower Ultramafic Unit with the Footwall Felsic Unit, immediately south of Silver Swan. The sulphide mineral assemblage is dominated by pyrite, millerite and vaesite (Groves *et al.*, 1974) and attains a maximum thickness of 35-40 metres. Two grade zones are evident, a high-grade footwall zone containing 5-7% sulphides grading 2-3% Ni. The high-grade zone is disc shaped in cross section and on the northern and southern limits is interfingered with low-grade zones, containing 1-2% sulphides grading 1 % nickel (Goode, 2002). The Cygnet deposit has a Mineable Reserve of 1.025mt @ 2.16% Ni. Thin high grade, randomly orientated, massive/semi massive sulphide veins grading 16%Ni, which have been interpreted to be remobilised are occasionally noted on the footwall side of the high-grade zone (Goode, 2002).

The Black Duck Orebody consists of a series of sinuous lenticular pods of massive sulphide, enclosed primarily by internal intermediate / felsic volcanics belonging to the Upper Felsic Unit I (Hill *et al.*, 1999). The massive sulphides are composed of pyrite, pyrrhotite, pentlandite and minor gersdorffite.

The Wood Duck massive pyrrhotite-pentlandite-pyrite sulphide mineralisation is located down dip of the Black Duck Orebody. It lies on a layer of partially melted Felsic Footwall Unit (Hill *et al.*, 1999). The ore body's thickness varies from 2-10m and has a maximum strike of approximately 35m.

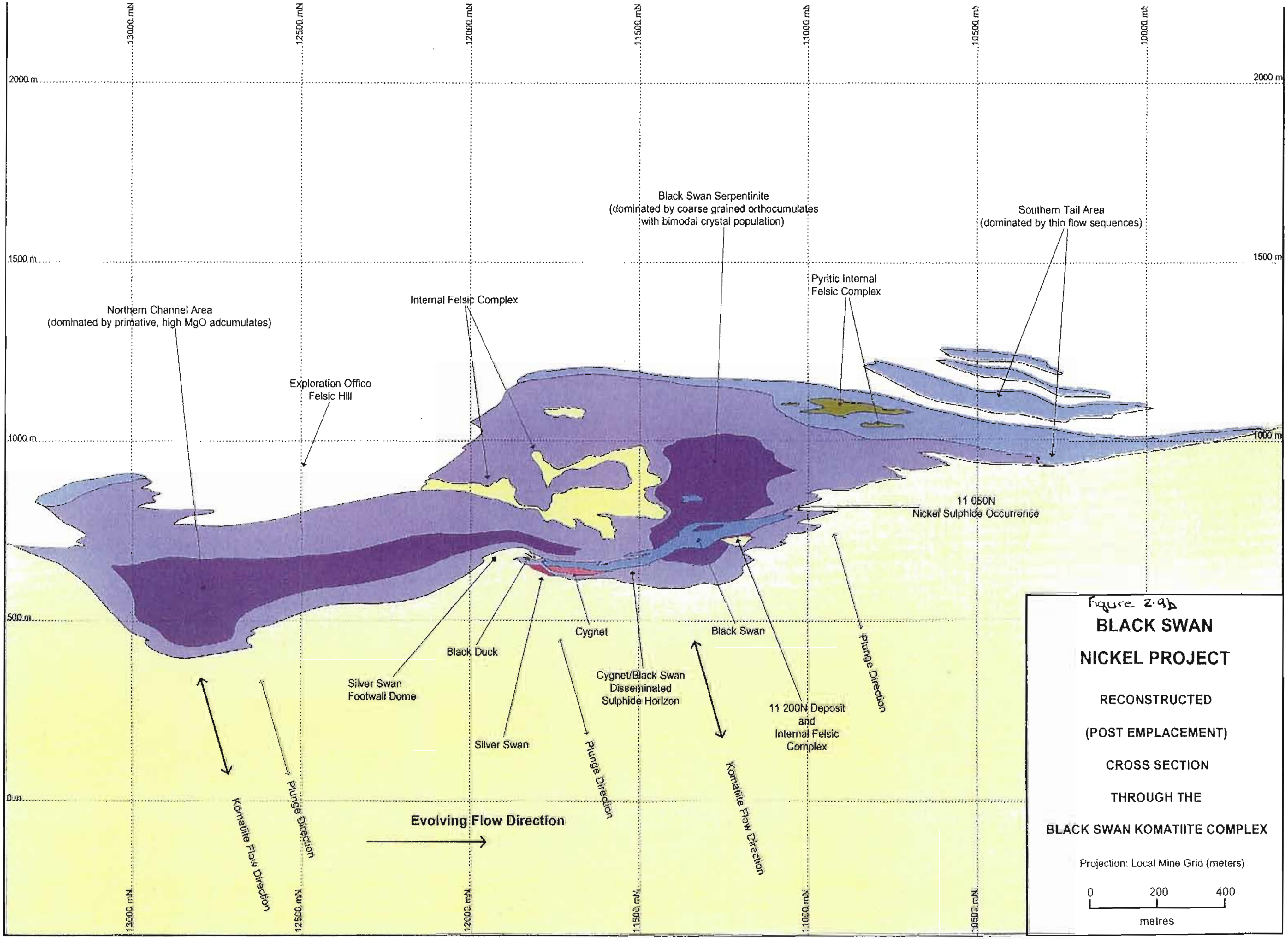
The 11200mN (Gosling) massive sulphide mineralisation is located 500m south of Cygnet, on an upper contact of an internal felsic volcanic flow unit, a large highly variable lens shaped northerly (45 degrees) plunging sequence, which is part of Upper Felsic Unit I, and consists pre-dominantly of pyrrhotite, pyrite and pentlandite (Goode,2002).

Figure 2.9b is a schematic diagram illustrating the position of the ore bodies in relation to the Black Swan Komatiite and basal contact.

2.4 History of Use of Geophysical Techniques at Silver Swan.

Prior to this study, during the exploration and development of the Silver Swan mine a variety of geophysical surveys were carried out.

During routine geological logging, magnetic susceptibility readings were taken using a hand held meter, and density was established with the displaced water method. Systems Exploration (NSW) Pty Ltd measured the magnetic susceptibility and conductivity of the ore rock on a single sample.



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A number of holes were surveyed using the OMS-LOGG tool, which measured gamma-gamma, natural gamma, conductivity, magnetic susceptibility and resistivity.

Petrophysical properties as documented by Amann & Pietila (1998) are shown in Table 2.3.

TABLE 2.3 Petrophysical properties of Silver Swan

	Density G/cm	**Magnetic Susceptibility SI**	**Conductivity S/m**	**Resistivity Ohm-m**
Country rock	2.7	Low	Na	20000
Host (Carb)	2.85	0.00005	Na	150-800
Host (Serp)	2.95	0.1	Na	10000
Massive Ore	4.76	0.15	very high	<0.00001
Footwall	2.7	<0.00005	na	20000

2.4.1 Magnetics

Prior to the discovery of the Silver Swan deposit, 200m spaced regional aeromagnetic data (Figure 2.10) was purchased, with the aim of delineating the ultramafic boundary and locating possible strike extensions of the stratigraphy. A geomagnetic interpretation (Figure 2.11) based on published geology (Ahmat, 1987-89) and unpublished geology from WAMEX open file data was produced.

A 50m line spaced and 15m mean terrain clearance helicopter borne magnetic survey was flown in 1995. The total magnetic field image is shown in Figure 2.12 overlain by the outcrop geology map with the boundary of the ultramafics as defined by drilling.

Ground magnetic surveys were found to be of little use as a mineralisation-targeting tool due to surficial noise from the weathering profile.

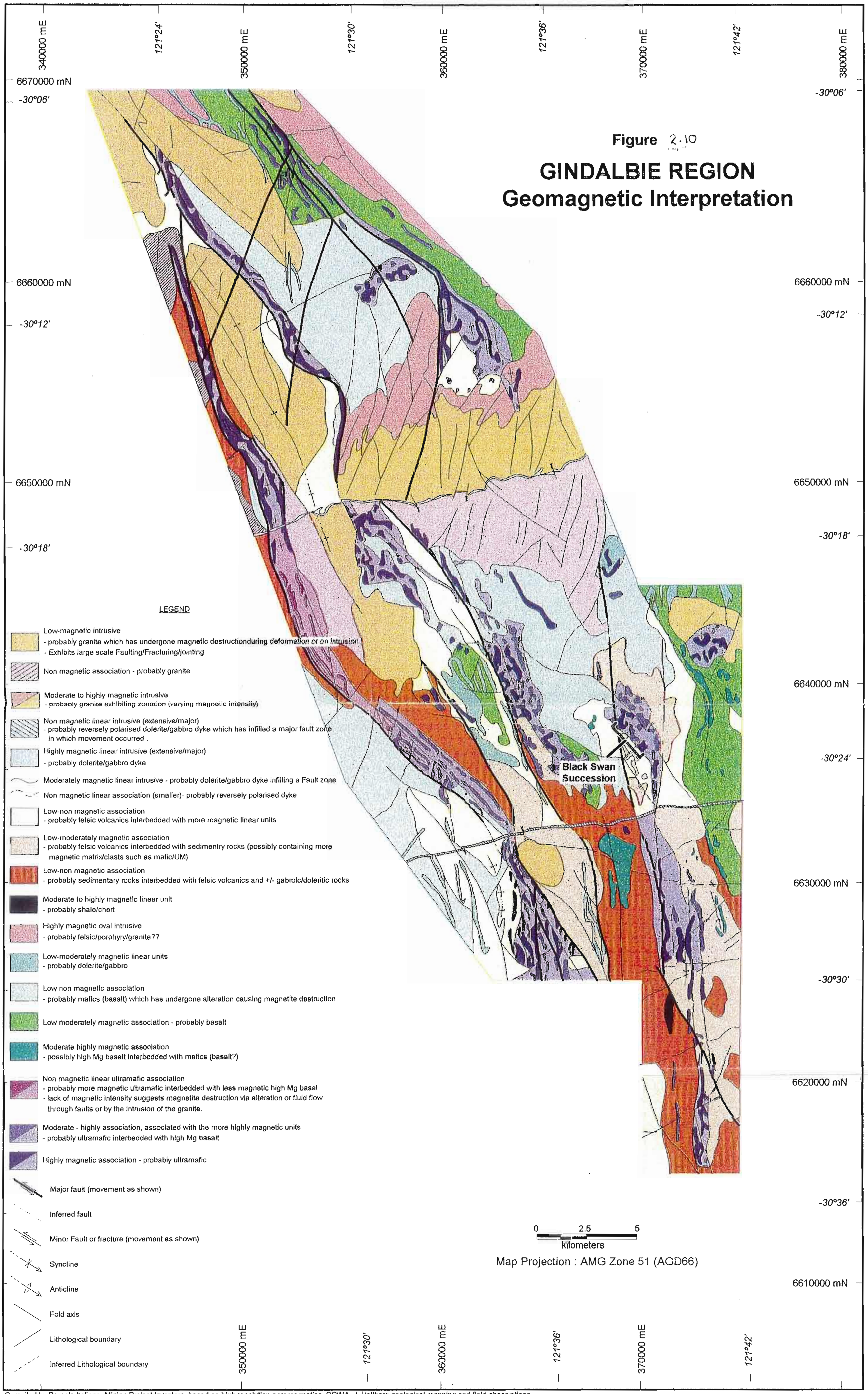
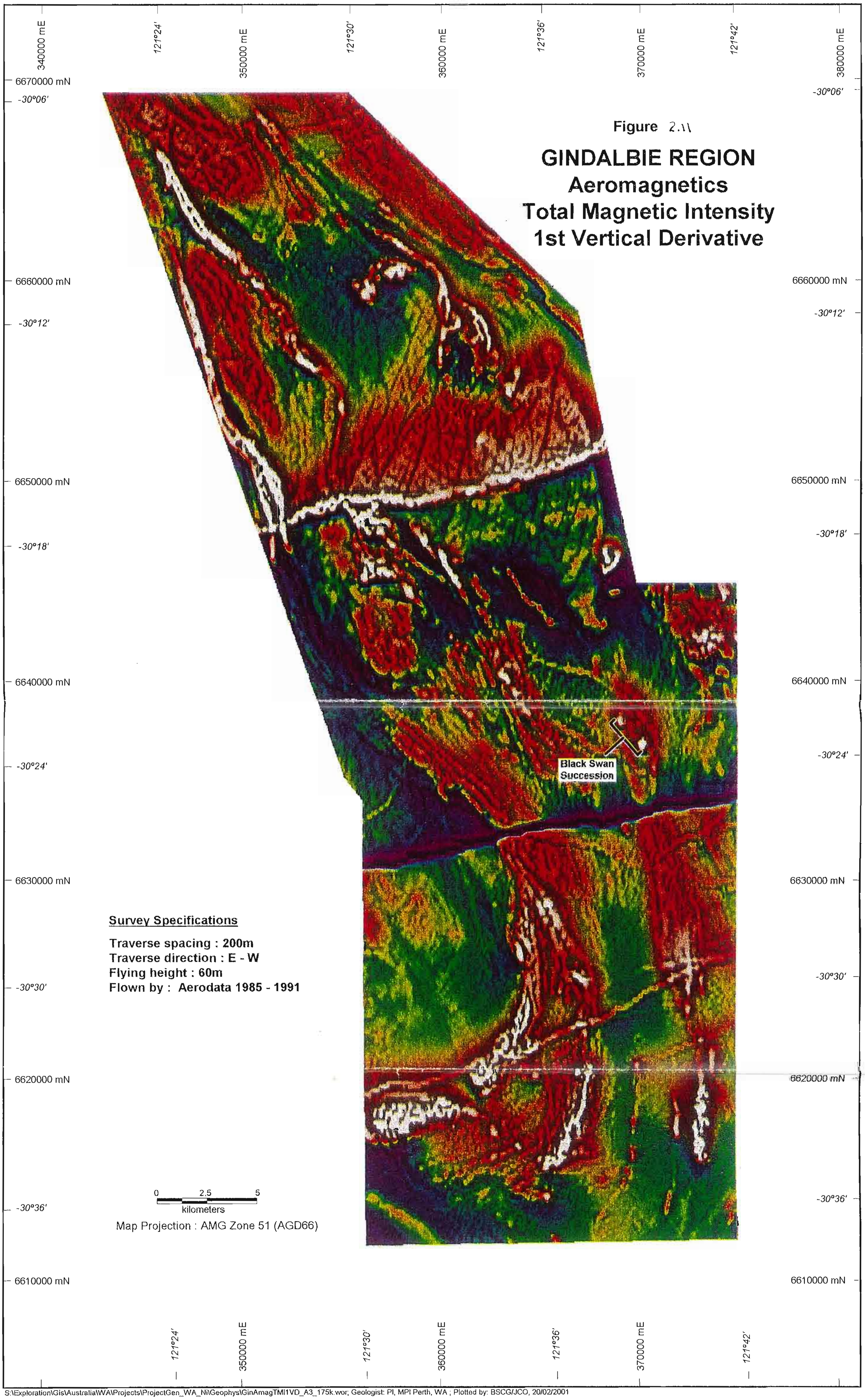


Figure 2.10
GINDALBIE REGION
Geomagnetic Interpretation

Compiled by Pamela Italiano, Mining Project Investors, based on high resolution aeromagnetics, GSWA, J. Hallberg geological mapping and field observations.
S:\Exploration\GIS\Australia\WA\Projects\ProjectGen_WA_Ni\Geophys\GinAMagInterp_A3_175k.wor, Plotted by BSCG/JCO, 20/02/2001



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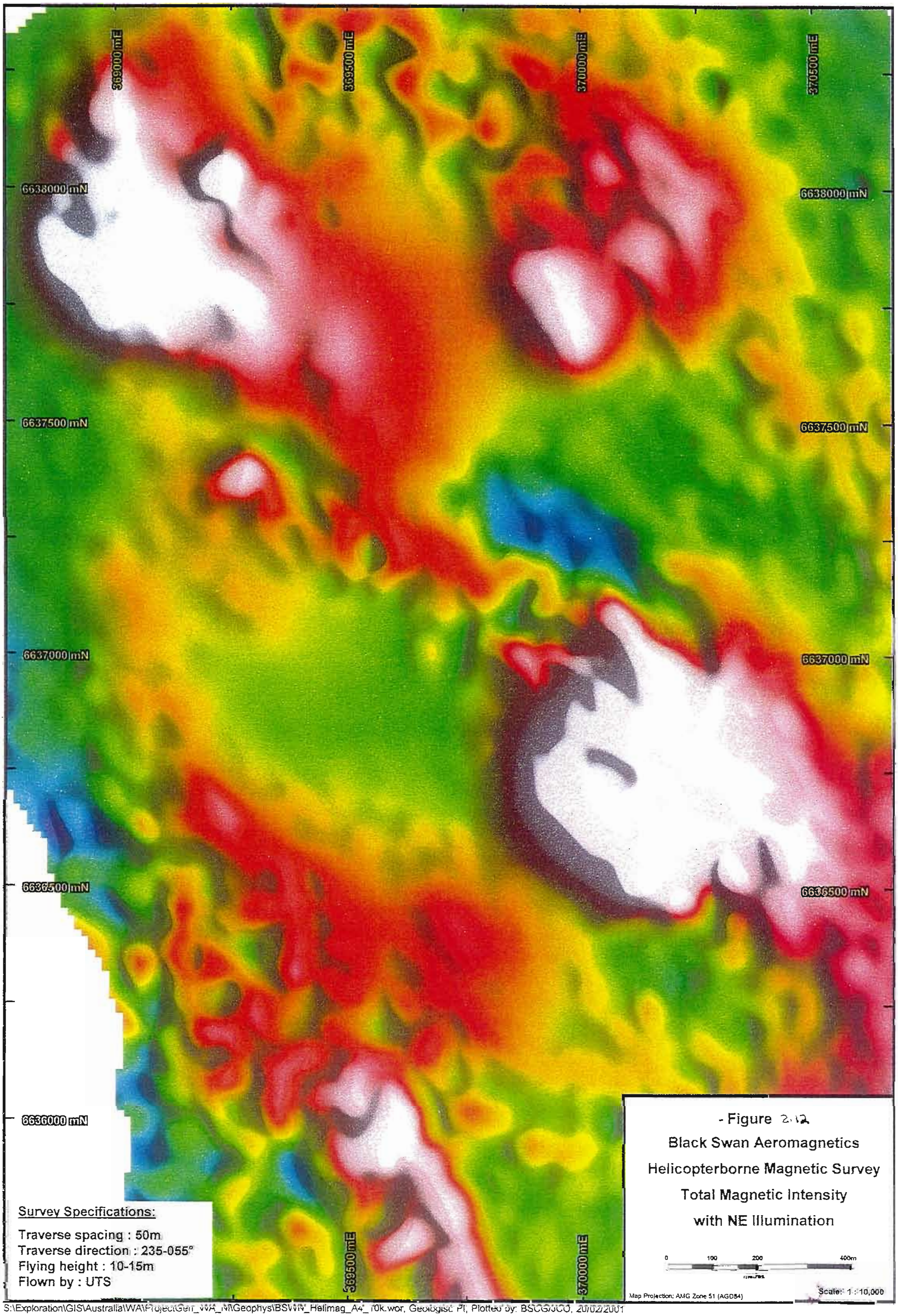

- Figure 2.12
Black Swan Aeromagnetics
Helicopterborne Magnetic Survey
Total Magnetic Intensity
with NE Illumination

Survey Specifications:

Traverse spacing : 50m
Traverse direction : 235-055°
Flying height : 10-15m
Flown by : UTS

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2.4.2 Ground Electromagnetics

A variety of electromagnetic surveys were conducted over the Black Swan area due to the conductive nature of the target. Surveys included:

- Moving in-loop Mark3 Sirotem from 200m transmitter loops;
- A fixed loop survey over the ore zone;
- Gefinex 400S survey, which is an Outokumpu in-house broadband 2-20kHz frequency domain system operating in slingram configuration; and,
- Crone PEM using the 150ms time base in both fixed and moving loop mode.

No anomalies could be directly attributed to a response from the massive sulphides.

2.4.3 Gravity

A Scintrex CG3 meter was used to carry out a gravity survey, to an observed accuracy of 0.01mGal. The position and elevation of the gravity stations was defined using a Kinematic GPS, which gave an accuracy of ± 0.05m. Generally, 250m-line spacing with 40m stations were recorded although 20m stations were observed along line 11750n directly over the Silver Swan massive sulphide shoot.

It was concluded that due to the strong influence and irregular nature of the weathering surface, gravity could not directly detect the ore zone and therefore was not recommended as a tool for routine exploration (Amann & Pietela, 1998).

2.4.4 Downhole Electromagnetics

To delineate the Silver Swan Ore body and to aid discovery of any potential neighbouring mineralisation, DHTEM techniques were routinely used. The main tool was the Crone three-component system. Rectangular and square loops with side lengths generally smaller than the expected target depth were deployed in a position to maximally couple with a target assumed to be parallel to the footwall contact (Amann & Pietila, 1998). These workers reported that the DHTEM technique was the most useful tool in directing deep drilling and in sterilising the target basal contact around each barren drill hole.

Protem (three component at 2.5hz), Crone (three component at 150ms time base) and single component systems (using higher power and very long time bases) were trialed only to establish the late time signal levels tended to be within the ambient noise level thus degrading interpretability.

2.4.5 Mise a la Masse

Hole to surface and hole-to-hole mise a la masse surveys were applied to delineate the Silver Swan orebody. According to Amann & Pietila (1998), hole-to-hole misse a la masse was very useful for ore zone delineation but was impossible to use on deeper holes that involved navigation drilling from one parent hole.

2.5 Summary

Airborne magnetic surveys were useful in indicating the presence of ultramafic lithologies in the Black Swan Project area as was the regional gravity survey, and hence could be considered vectors toward the correct basic volcanological environment. However, these surveys could not be used to discriminate magmatic nickel sulphide orebodies.

Traditional surface geophysical exploration methods have proven to be of little use in targeting magmatic nickel sulphides within the Black Swan Succession. Ground magnetic and gravity surveys were deemed superfluous due to the nature of the weathering profile. No ground electromagnetic anomalies could be directly attributed to a response from the massive nickel sulphides.

Within the Black Swan Succession, the Crone Three Component system is routinely used to help delineate the orebody as described by Amann & Pietela (1998). DHTEM was noted as the most useful tool in directional deep drilling and for sterilization of the target basal contact around barren holes.

Thus, it can be seen that the Black Swan Succession orebodies are difficult to detect with conventional geophysical techniques, with the exception of DHTEM, whereby one must be within approximately 50m of the orebody.

The traditional ground and downhole techniques were not successful in geophysically typecasting the sulphide mineralisation. The aim of this study is to geophysically typecast Komatiite flows hosting mineralisation so to discriminate the trough from the flanks thus providing vectors to the nickel sulphide mineralisation.

As already noted there is commonly no distinct variation in magnetic signatures between the Komatiites and the felsic volcanic rocks with the Black Swan Succession. The conductivity of the rocks should indicate the presence of magmatic nickel copper sulphides. Variation in densities of the rocks has not been studied in detail and requires consideration.

CHAPTER THREE

Methodology

3.0 METHODOLOGY

3.1 Theory of Geophysical Techniques Utilised

Fallon *et al.* (1997) classify the measurable geophysical properties of rocks into six broad groups:

- radiogenic - natural gamma, XRD, XRF;
- mass properties - density, porosity, permeability;
- magnetic - susceptibility, remanence;
- strength - sonic velocity, Poisson's ratio, elastic moduli;
- electrical - resistivity or conductivity, induced polarisability; and,
- optical - reflectance, luminescence.

In this study, the magnetic, mass and electrical properties of various facies of the BSS were measured. The actual techniques included magnetic susceptibility, density, and conductivity. A description of each of the techniques is outlined below.

3.1.1 Induced/Remanent Magnetism and Susceptibility

Magnetic surveying methods measure the absolute changes in the Earth's magnetic field (refer Figure 3.1). The Earth's magnetic field is a vector comprised of two components – induced and remanent magnetisation. The properties of the subsurface materials, which produce variations in the Earth's magnetic field, are magnetic susceptibility variations and remanent magnetisation.

Induced magnetism is acquired when the elementary dipoles within a material become aligned with an external field, such as that of the Earth. The strength of the induced magnetisation depends on the strength of the applied field and a property of a material known as its magnetic susceptibility (K).

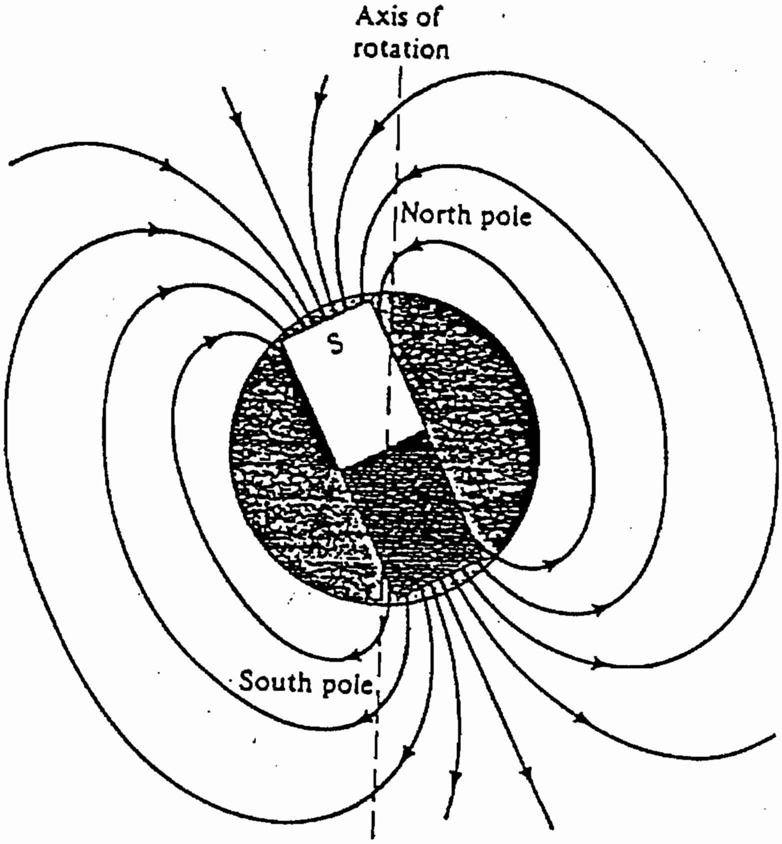


Figure 3.1 The Earth's magnetic field represented by a bar magnet inclined to the axis of rotation. Note that the south or negative pole of the bar magnet is actually located at the geographical north end of the Earth. A compass points to north because it becomes aligned within the direction in which the flux lines of the Earth are flowing. (From Marion, 1976.)

Magnetic susceptibility is the dimensionless ratio of the field induced in the material to the external magnetic field. Susceptibility is primarily controlled by the magnetite content of the rock. All materials have a magnetic susceptibility.

Most materials display diamagnetic behaviour, corresponding to a negative susceptibility and a small-induced field opposing the applied field. Substances containing unpaired electrons display paramagnetic behaviour, which corresponds to a small, positive susceptibility. This is independent of the applied field but dependent on temperature. Materials, which show a natural alignment of magnetic moments in small domains in the presence of an applied field, display ferri magnetic behaviour. In this case, susceptibility is a function of both the applied field and temperature. Table 3.1a and 3.1b show the susceptibilities of common rock and mineral types with the general ranges being illustrated in Figure 3.2.

Table 3.1a MAGNETIC SUSCEPTIBILITIES OF VARIOUS ROCKS

Type	Susceptibility Range	x 10^4 emu Average	Type	Susceptibility Range	x 10^4 emu Average
Sedimentary			**Igneous**		
Dolomite	0-75	10	Granite	0-4000	200
Limestones	2-280	25	Rhyolite	20-3000	
Sandstones	0-1660	30	Dolerite	100-3000	1400
Shales	5-1480	50	Augite-Syenite	2700-3600	
Av. Var. Sed. (48)	0-4000	75	Olivine-Diabase		2000
Metamorphic			Diabase	80-13,000	4500
Amphibolite		60	Porphyry	20-16,700	5000
Schist	25-240	120	Gabbro	80-7200	6000
Phyllite		130	Basalts	20-14,500	6000
Gneiss	10-2000		Diorite	50-10,000	7000
Quartzite		350	Pyroxenite		10,500
Serpentine	250-1400		Peridotite	7600-15,600	13,000
Slate	0-3000	500	Andesite		13,500
A. Var. Met.(61)	0-5800	350	Av. Acid Ign	3-6530	650
			Av. Basic Ign.	44-9710	2600

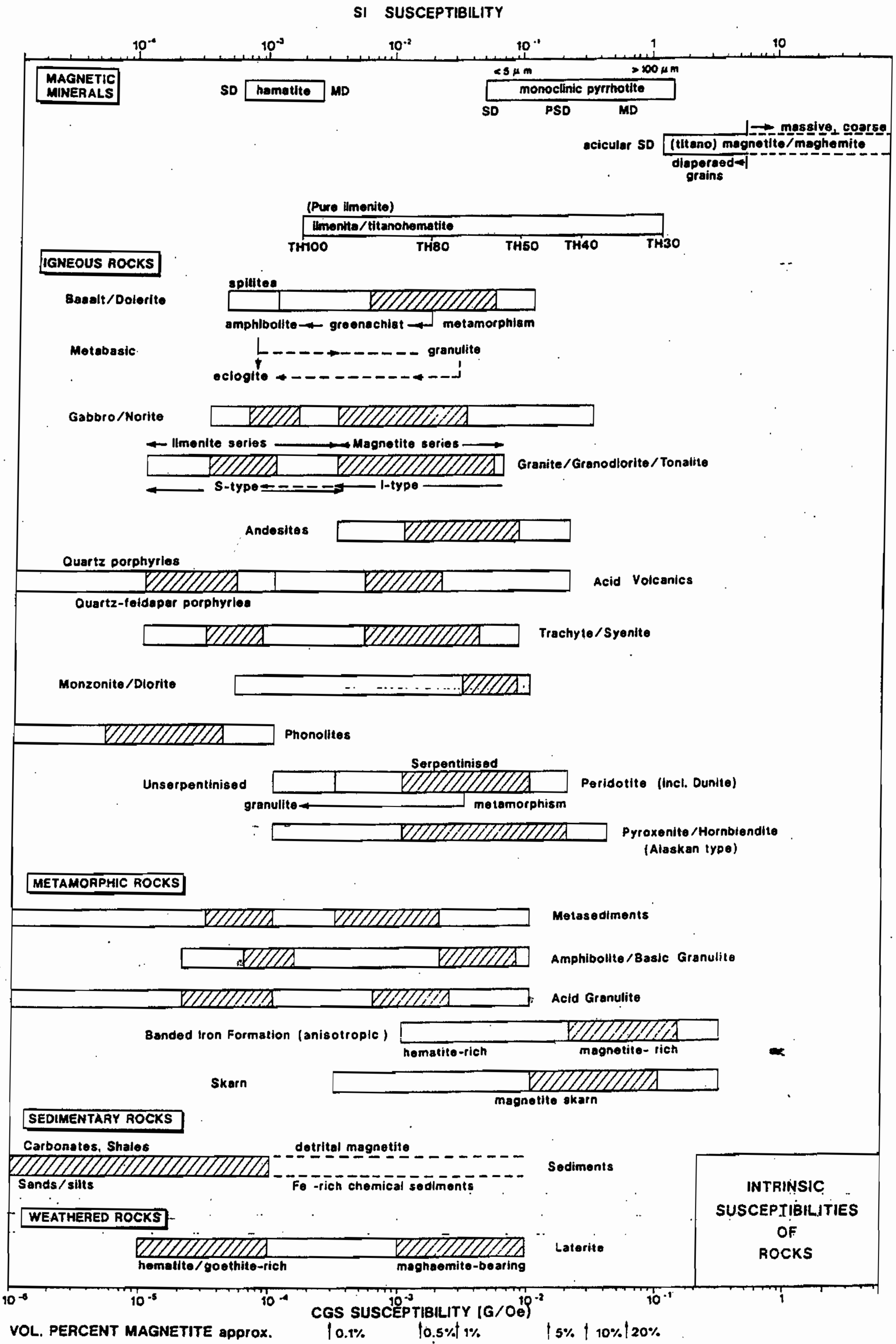


Figure 3.2 Susceptibility. (After Clark, 1983.)

Table 3.1b MAGNETIC SUSCEPTIBILITIES OF VARIOUS MINERALS

Type	Susceptibility Range	x 10^4 emu Average	Type	Susceptibility Range	x 10^4 emu Average
Graphite		-8	Arsenopyrite		240
Quartz		-1	Haematite	40-3000	550
Calcite	-0.6- -1		Chromite	240-9400	600
Clays		20	Pyrrhotite	10^2-5 x 10^5	125,000
Sphalerite		60	Ilmenite	2.5x10^4 - 3x10^5	1.5 x 10^8
Pyrite	4-420	130	Magnetite	10^5-1.6 x 10^4	5 x 10^8
Pyrite	4-420	130			

(After Telford *et al.*, 1990)

Once the applied or external field is removed, the induced magnetisation is lost. However, many rocks are capable of carrying a remanent or permanent magnetisation that remains after the external field is removed. It is regarded as a static property independent of weak applied fields.

There are many ways a rock can acquire natural remanent magnetisation (NRM). The most important is the thermo-remnant magnetisation (TRM), which results when magnetic material is cooled below the Curie point in the presence of an external field. Its direction depends on the direction of the field at the time and place where the rock is cooled.

Remanence, while also dependant upon magnetite content, is sensitive to factors such as grainsize, microstructure of magnetic minerals and geological history (Clark & Emerson, 1991). Figure 3.3 shows the ranges of natural remanent magnetisation of common rock types.

Most modern magnetometers only measure total field intensity. As there are several types of magnetometers, each is chosen with respect to the type of survey (e.g. ground or

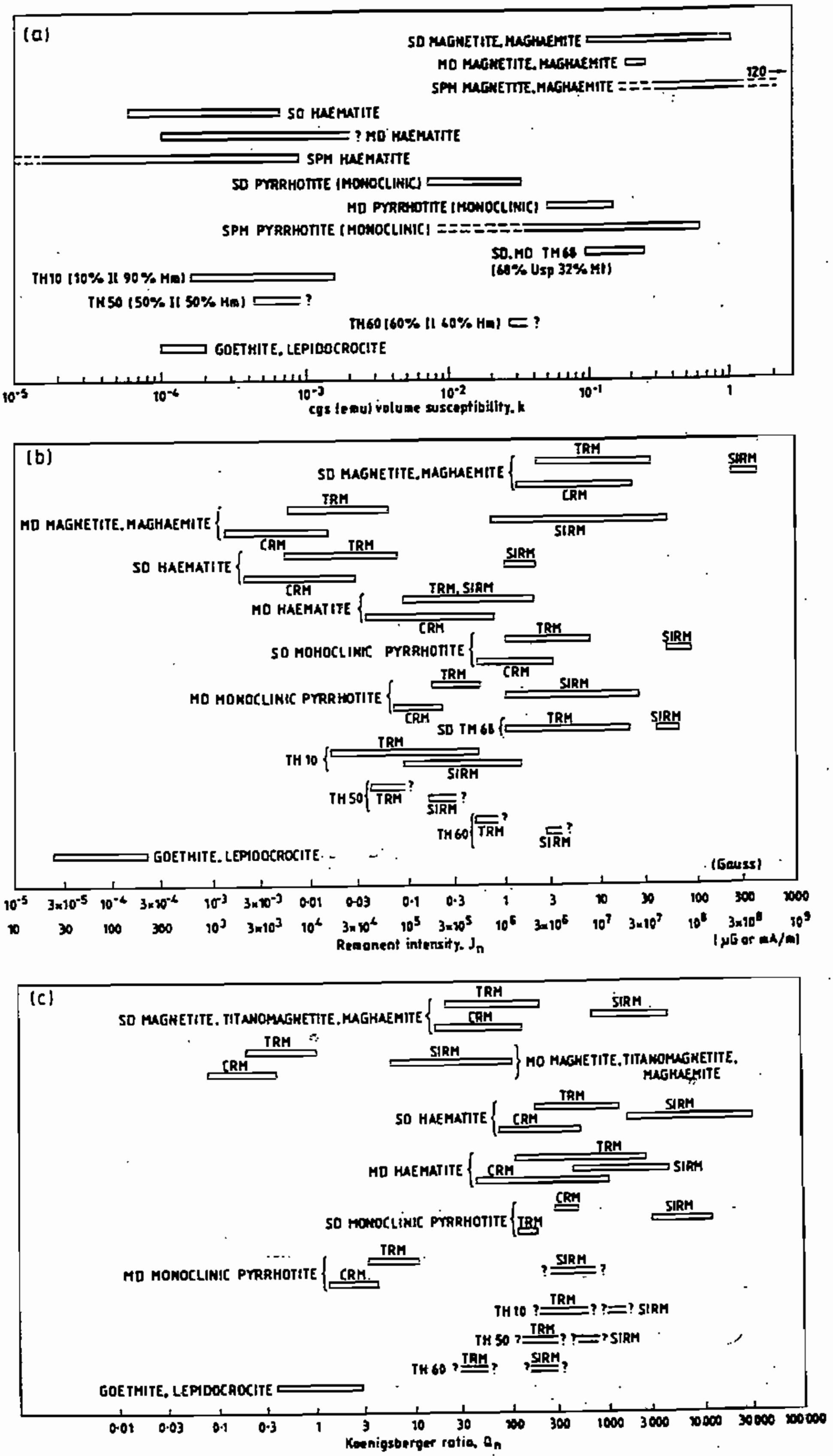


Figure 3.3 Magnetic Properties of Minerals. SD = single domain, MD = multidomain, PSD = pseudosingle domain, THx = ilmenite-hematite solid solution containing 100x mole per cent ilmenite. (From Clark and Emerson, 1991.)

airborne), accuracy required, and ease of use. The magnetometer most commonly used for ground surveys is the proton-precession magnetometer. Aeromagnetic methods use optically pumped magnetometers.

Susceptibility can be measured either in the field, on rocks *in situ* using a hand held susceptibility meter (Kappameter), or in the laboratory for hand specimens. Repeated readings are taken in the field on flat rock surfaces. These values can then be averaged to calculate the geometric mean for each distinguishable rock unit. Susceptibility values are plotted against a logarithmic scale as susceptibility data form a log normal distribution (see Tarling, 1996).

Remanent magnetisation measurements can only be measured in the laboratory by using a spinner or astatic magnetometer.

3.1.2 Remanence of Ultramafic Rocks

Clark & Emerson (1991) state that the remanence carried by magnetically soft multidomain magnetite, which is the dominant magnetic phase in many rocks, is dominated by viscous magnetisation. This remanence is subparallel to the present field and therefore augments the induced magnetisation, enhancing the effective susceptibility; this is common in serpentinites. Thus, most anomalies can be interpreted in terms of magnetisation by induction, even when typical Koenigsberger ratios are comparable to unity. However, the anomaly amplitudes may be larger for a given source geometry than measured susceptibilities indicate, due to the viscous remanent magnetisation.

The natural remnant magnetisation (NRM) should be lowest in the talc-carbonate rocks and highest in the serpentinised ultramafics as these contain the greatest volume of magnetic oxide (Emerson, 1991). The neglect of remanence may therefore mislead quantitative interpretation, even though the anomaly form is consistent with an induced response parallel to the present field. Remanence does not appear to affect dip or shape interpretation, just amplitude.

3.1.2 *Density*

Density as defined by Olhoeft & Johnson (1989), is a physical property that changes significantly among various rock types owing to differences in mineralogy and porosity. Density is calculated by the equation:

$$D = m/V$$

where the density d is defined as the quotient of the mass m and the volume V of a material. The SI unit for density is kg/m^{-3} ($1\ g/cm^{-3} = 10^3\ kg/m^{-3}$).

The bulk densities of rocks depend on their mineral composition, the content of enclosed pore or fracture space, and the filling material.

The total rock density can be calculated (Schon, 1996) using the equation:

$$d = Sum\ (n\ /sum/I{=}1)(V_I/V).d_I$$

where:

d, (bulk density) refers to the mean density of the rock volume, including pore or fluid density;

d_I is the density of an individual rock component I;

d_m is the mean density of the solid matrix material; and,

d_p is the mean density of the pore- (or fracture) fluid.

In addition, where d_i is the density and V_1 is the volume of the component i; the ratio V_I /V is the volume fraction of the component i.

As the volume content of pores and/or cracks is relatively small in igneous rocks and most metamorphic rocks, this element can be ignored. In contrast, sedimentary rocks are generally porous and 'dense', with the influence of pore volume or porosity, and pore filling on bulk density being very strong.

Igneous rocks are generally denser than sedimentary rocks, although there is considerable overlap. The mean density ranges for igneous and metamorphic rocks are illustrated in Table 3.2. As a result of the very small influence of the pore- or fracture volume, the range of values for each rock type is quite small. There is also a tendency towards increasing density from acid to basic rocks (refer Figure 3.4).

Table 3.2 DENSITIES OF VARIOUS ROCKS AND MINERALS

ROCK TYPE	Range (g/cm^3)	Average (g/cm^3)	Mineral	Range (g/cm^3)	Average (g/cm^3)
Sediments (wet)			**Metallic Minerals**		
Overburden		1.92	***Oxides, carbonates***		
Soil	1.2-2.4	1.92	Bauxite	2.3-2.55	2.45
Clay	1.63-2.6	2.21	Limonite	3.5-4.0	3.78
Gravel	1.7-2.4	2.0	Siderite	3.7-3.9	3.83
Sand	1.7-2.3	2.0	Chromite	4.3-4.6	4.36
Sandstone	1.61-2.76	2.35	Ilmenite	4.3-5.0	4.67
Shale	1.77-3.2	2.40	Pyrolusite	4.7-5.0	4.82
Limestone	1.93-2.90	2.55	Magnetite	4.9-5.2	5.12
Dolomite	2.28-2.90	2.70	Haematite	4.9-5.3	5.18
Sedimentary rocks (av.)		2.50	Cuprite	5.7-6.15	5.92
Igneous			***Sulphides, arsenides***		
Rhyolite	2.35-2.70	2.52	Sphalerite	3.5-4.0	3.75
Andesite	2.4-2.8	2.61	Malachite	3.9-4.03	4.0
Granite	2.50-2.81	2.64	Chalcopyrite	4.1-4.3	4.20
Granodiorite	2.67-2.79	2.73	Pyrrhotite	4.5-4.8	4.65
Porphyry	2.60-2.89	2.74	Marcasite	4.7-4.9	4.85
Quartz diorite	2.62-2.96	2.79	Pyrite	4.9-5.2	5.0
Diorite	2.72-2.99	2.85	Bornite	4.9-5.4	5.10
Lavas	2.80-3.00	2.90	Chalcocite	5.5-5.8	5.65
Diabase	2.50-3.20	2.91	Cobaltite	5.8-6.3	6.10
Basalt	2.70-3.30	2.99	Arsenopyrite	5.9-6.2	6.10
Gabbro	2.70-3.50	3.03	Galena	7.4-7.6	7.50
Peridotite	2.78-3.37	3.15	Pentlandite	4.6-5.0	
Acid igneous	2.30-3.11	2.61			
Basic igneous	2.09-3.17	2.79	Graphite	1.9-2.3	2.15
Metamor			Gypsum	2.2-2.6	2.35
Quartzite	2.5-2.7	2.60	Kaolinite	2.2-2.63	2.53
Schists	2.39-2.9	2.64	Orthoclase	2.5-2.6	–
Graywacke	2.6-2.7	2.65	Quartz	2.5-2.7	2.65
Chlorite	2.6-2.9		Calcite	2.6-2.7	–
Serpentine	2.4-3.10	2.78	Anhydrite	2.29-2.30	2.93
Slate	2.7-2.9	2.79	Biotite	2.7-3.2	2.92
Gneiss	2.59-3.0	2.80	Magnesite	2.9-3.12	3.03
Amphibolite	2.90-3.04	2.96	Pyroxen-ortho	3.21-3.96	
Lizardite	2.5		Fayalite $FeSiO_4$	4.39	
Antigorite	2-3.5				
Talc	2.58-2.83				
Tremolite	3.02-3.44				

(After Telford *et al.*, 1990)

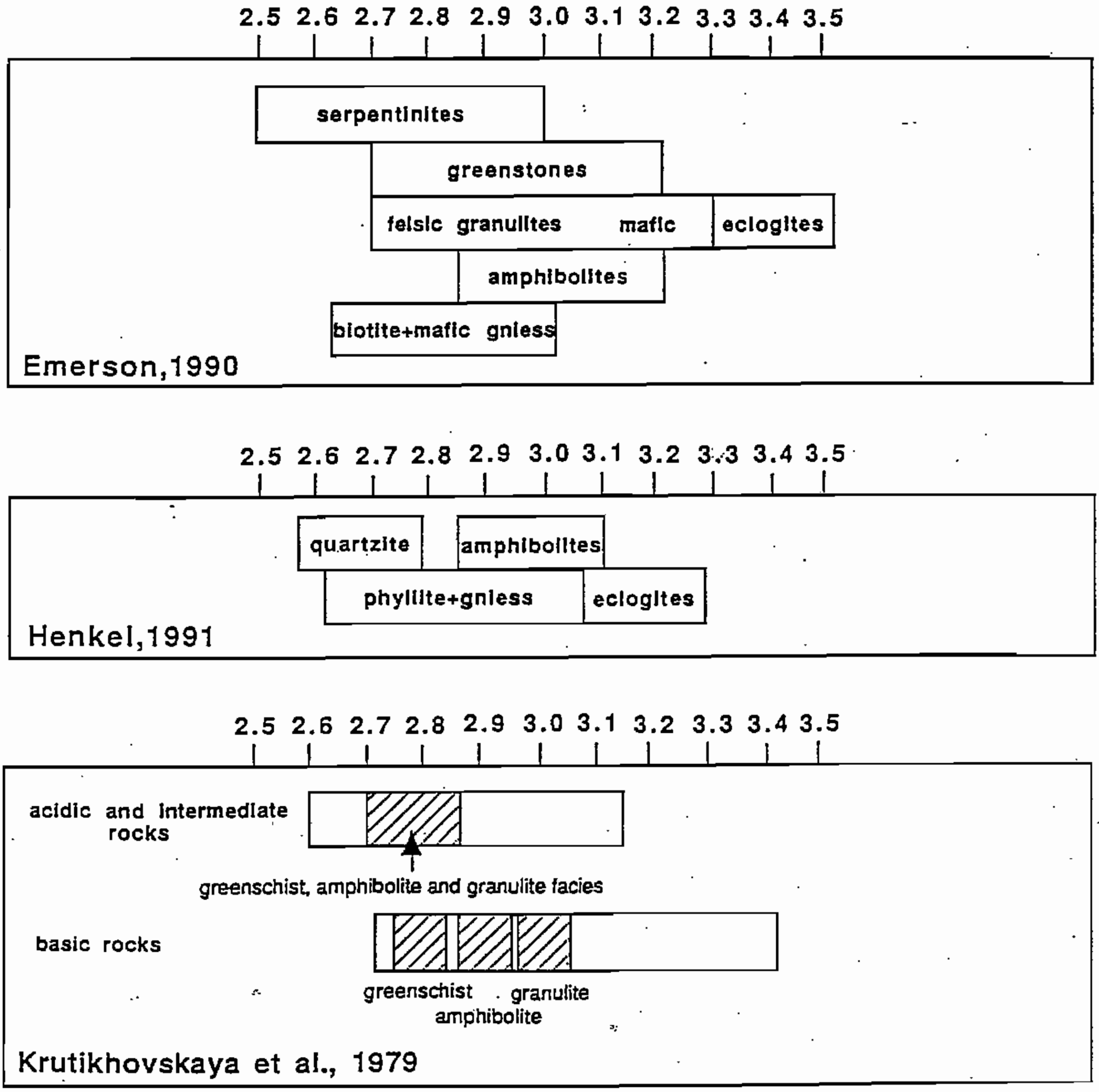


Figure 3.4 Densities of Common Metamorphic Rocks (g/cm3).

Density generally increases with the degree of metamorphism because the process tends to fill pore spaces and recrystallise the rock into a denser form (Telford *et al.*, 1990). Non-metallic minerals generally have lower densities than the average for rocks (2.67 g/cm3). Although metallic minerals tend to be heavier than this average, they rarely occur in their pure forms in large volumes, and hence their effect is normally not great (Telford *et al.*, 1990).

Density is not commonly measured *in situ* but it can be measured by borehole logging tools. The density log, or gamma-gamma log, is a commonly used nuclear log. Nuclear logs are related to measurement of natural or induced radioactivity in a formation. The logs record only the bulk density, i.e. overall density, including solid matrix and fluid enclosed in the pores. From a geological perspective, the bulk density of a rock is a function of the density of the minerals forming the rock. Qualitatively, density is a useful lithology indicator, and can also be used to identify certain minerals.

The logging tools have a medium energy, natural gamma-ray source and two detectors mounted in a metal, plough-shaped pad kept in firm contact with the borehole wall. The tool makes use of the photoelectrical effect. At energy levels below scattering, gamma rays become so attenuated that they are captured and absorbed. With a gamma-gamma density log, density is measured based on Compton scattering. The density is not measured in g/cm^3 but rather electron density, where the difference between the atomic weight and the atomic number of the atoms is measured, making use of the photoelectric effect. The effect is dependent on both mediums' electron density and atomic number. The log records the formation photoelectric absorption index (Tully, 1994).

This gamma-gamma density d_{ig} (or electron density) is related to the density defined above as:

$$D_{ig} = d. (2.Z/A)$$

where Z is the atomic number and A the atomic mass.

The tools have a medium energy natural gamma-ray source and two detectors mounted in a metal, plough-shaped pad kept in firm contact with the borehole wall. The counting-rates made by both detectors of gamma-ray attenuation due to the effect are directly related to electron density, which can be related to bulk density (McCann *et al.*, 1981).

3.1.3 Resistivity / Conductivity

Electrical prospecting involves the detection of surface effects produced by electric current flow in the ground. Using electrical methods it is possible to measure potentials, currents, and electromagnetic fields that occur naturally, or are introduced artificially in the earth. Electrical methods include self-potential (SP), resistivity including electromagnetic (EM), mise-a-la-masse, magnetotellurics (MT), and induced polarisation (IP).

The apparent resistivity of rocks and minerals is the physical property that determines the applicability of electrical and electromagnetic methods (Rutter, 1999). In the application of electrical methods the physical property of resistivity is used, whereas in the electromagnetic methods the same property is termed conductivity. Table 3.3 provides an extensive list of resistivity values for rocks. A conductor is defined as a material of resistivity less than 10^{-5} ohm/metre, whereas an insulator is one having a resistivity greater than 10^{7} ohm/metre. Conductors, such as the sulphide metals and graphite contain a large number of free electrons whose mobility is very great. Semi-conductors have fewer mobile electrons that carry current. The insulators are characterised by ionic bonding so that the valence electrons are not free to move.

Table 3.3 RESISTIVITIES OF VARIOUS ROCKS AND SEDIMENTS

Rock Type	Resistivity Range (Ω m)
Granite porphyry	4.5×10^3 (wet) - 1.3×10^6 (dry)
Feldspar porphyry	4×10^3 (wet)
Syenite	10^2 - 10^6
Diorite porphyry	1.9×10^3 (wet) - 2.8×10^4 (dry)
Porphyrite	10 - 5×10^4 (wet) - 3.3×10^3 (dry)
Carbonatized porphyry	2.5×10^3 (wet) - 6×10^4 (dry)
Quartz diorite	2×10^4 - 2×10^6 (wet) - 1.8×10^5 (dry)
Porphyry (various)	60 - 10^4
Dacite	2×10^4 (wet)
Andesite	4.5×10^4 (wet) - 1.7×10^2 (dry)
Diabase (various)	20 - 5×10^7
Lavas	10^2 - 5×10^4
Gabbro	10^3 - 10^6
Basalt	10 - 1.3×10^7 (dry)
Olivine norite	10^3 - 6×10^4 (wet)
Peridotite	3×10^3 (wet) - 6.5×10^3 (dry)
Schists (calcareous & mica)	20 - 10^4
Tuffs	2×10^3 (wet) - 10^5 (dry)
Graphite Schist	10 - 10^2
Slates (various)	6×10^2 - 4×10^7
Gneiss (various)	6.8 10^4 (wet) - 3×10^6 (dry)
Quartzites (various)	10 - 2×10^8
Consolidated Shales	20 - 2×10^3
Argillites	10 - 8×10^2
Conglomerates	2×10^3 - 10^4
Sandstones	1 - 6.4×10^4
Limestones	50 - 10^7
Dolomite	3.5×10^2 - 5×10^3
Unconsolidated Wet Clay	20
Clays	1 - 100

(after Telford *et al.*, 1990)

Ohm's Law is the starting point for the direct current resistivity method. The Law states:

$$R=\delta V/I$$

Where R is the electrical resistance, δV is the potential difference and I is the intensity of the current and is measured in ohms. This equation can be easily related to a piece of wire. The concept of resistivity involves the cross sectional area of the wire, or any other substance through which the current is flowing.

$$Resistivity\ (\rho) = RA/L.$$

Where A is the area of the wire (in square meters) and L is length. Resistivity is denoted by the Greek Letter ρ, and the resistivity unit is ohm-metre. The reciprocal of Resistivity is conductivity and is denoted by the Greek letter σ, and the units siemens per meter (S/m).

An induction log involves the same principle as frequency domain electromagnetic prospecting. A schematic diagram of an induction log is shown in Figure 3.5. The electromagnetic field produced by a transmitting coil induces magnetic and electric fields in the rocks around the hole. These fields generate in-phase and quadrature secondary magnetic fields at the receiver (Frignet, 1986). The induction-log signal is proportional to the conductivity of the formations.

Down hole electromagnetics (DHEM) involves transmitting an oscillating electric current into a wire loop positioned close to the area of interest (surface loops are the most common, but underground loops have been used). This results in an oscillating magnetic field being generated, which is detected by the receiver probe, positioned in a drill hole (Figure 3.6). The receiver is a coil, orientated so that it is co-axial with the drillhole.

A profile is built up by taking measurements of the change in magnetic field with time at a number of stations, usually at 5-10m intervals, along the hole. The magnetic field is composed of the primary field contribution (derivative of transmitted field) and the secondary field (Figure 3.7). The primary field contribution is a simple series of pulses while the secondary is derived from induced current flow decaying in the target (Eadie &

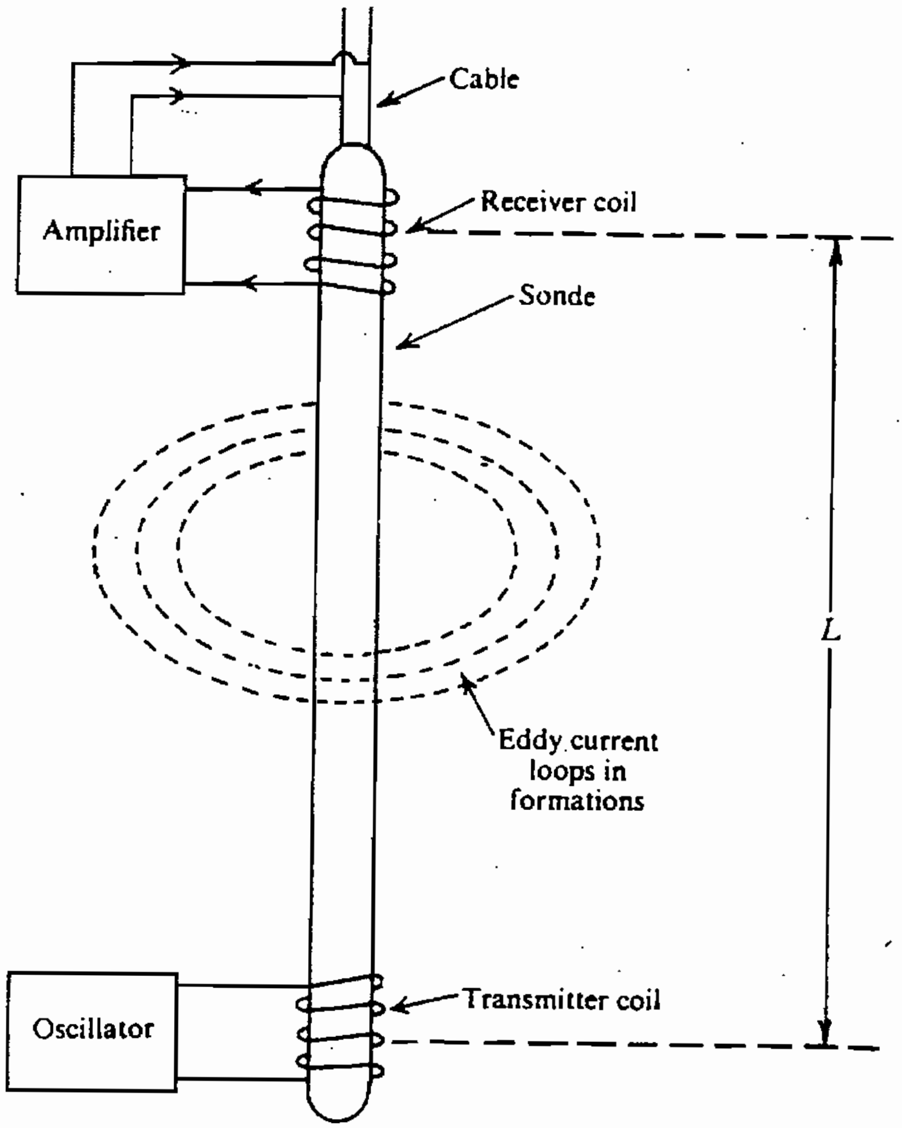


Figure 3.5 Induction log schematic. The tool itself is made of nonconducting material. (From Telford et al., 1990.)

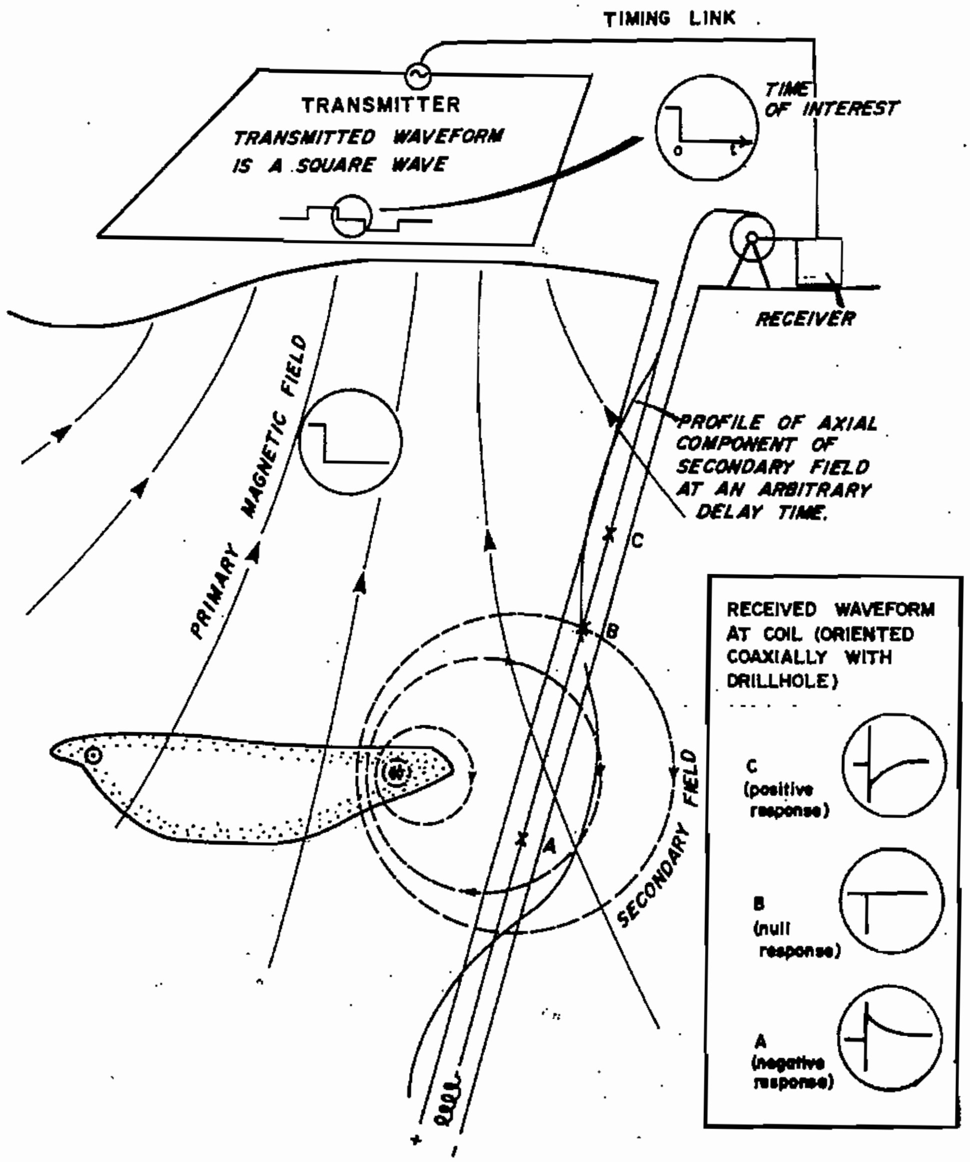


Figure 3.6 In DHEM, measurements are taken by a sensor coil that is lowered down the drillhole. The anomaly from an offhole, flat-lying conductor that is located directly beneath the transmitter loop has a central negative with two positive shoulders. In the case shown, positive has been defined as upwards. (Adapted from Dyck and West, 1984.)

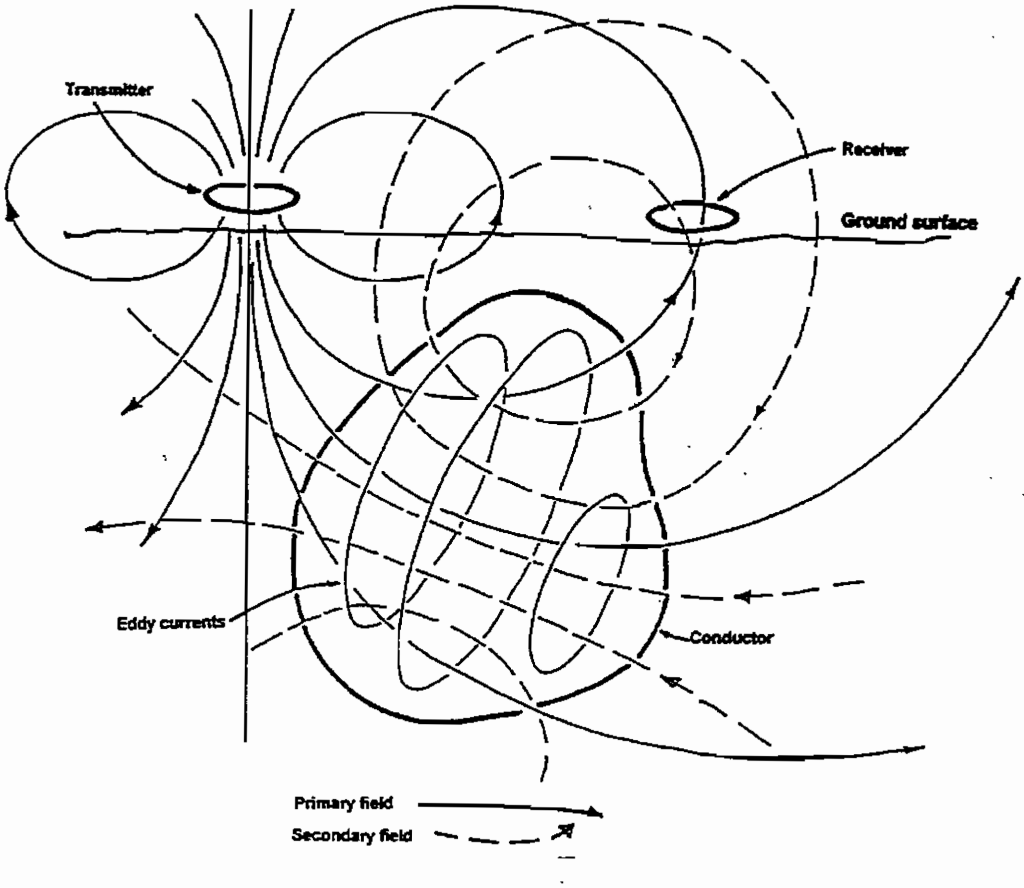


Figure 3.7 A generalised picture of electromagnetic induction prospecting. (After Van Blaricom, 1992.)

Staltari, 1988). The transient voltage decay is sampled during the interval between pulses of current.

If conductors are present, an anomaly will appear on the profile. From the shape of this anomaly, the size and approximate position of the conductor can be determined. More conductive bodies produce longer decays, and their anomalies can be recorded at later times (Wellington, 1997). DHEM is used in mine extensional exploration as it can increase the efficiency of the drilling in a number of ways:

- Drill spacings can be increased as DHEM has a large search radius around a drill hole (this search radius depends on the size and conductivity of the target).
- When an anomaly is detected, a vector towards the mineralisation can be given through detailed modelling.
- When mineralisation is intersected, DHEM surveys can give an indication of the size of the body and its attitude.
- Areas where no anomalies are detected can be identified as having minimal potential therefore lowering drill priority (Wellington, 1997).

The application of down-hole EM, in particular transient EM (DHTEM), has become more common in recent years, even though interpretation of the results is often difficult. The field procedure is simple. The transmitting loop is laid out on the surface, either over the zone of investigation or off to one side, depending on the directional information being sought. A square wave is transmitted into this loop for impulse response systems. The receiving loop is raised up the hole stopping at discrete intervals to take readings. The purpose of down-hole EM surveys is to locate a conductive body recognised in the surface data but not intersected in the drilling.

3.1.5 Induced Polarisation

When a current is flowing in the ground, some parts of the rock mass become electrically polarised. If this electric current is terminated, the voltage between the potential electrodes does not drop to zero instantaneously. It relaxes for a period of several seconds starting with an initial value, which is a small fraction of the voltage V_p when the current was flowing. This event is termed induced polarisation (IP), whereby the ionic current flow is converted to electronic current flow. Disseminated sulphide minerals can produce large polarisation effects, and IP techniques are widely used in exploring for base metals.

Induced polarisation can be measured in the time-domain as a voltage decay curve, in the frequency-domain as a voltage difference with variation in frequency, and in the phase-domain as a phase lag angle (Sumner, 1979). The residual voltage V existing at a definite time t (msecs) after the current is switched off, is compared with the maximum primary voltage V_p measured while the current was flowing. Time-domain chargeability is expressed in terms of decay voltage at times later than 1/10ms. It is quite common to measure an area under a decay curve using integrating circuitry rather than instantaneous voltage. When the integral of the time is used, results depend on the length of the integration period as well as the delay, and are quoted in milliseconds. This is the chargeability integral.

Chargeability can be considered as a fundamental measure of the intrinsic polarisability of a rock. It is sometimes known as intrinsic IP or as the intrinsic chargeability response. This can be measured in a laboratory, a drillhole, or on the surface when employing small physical property arrays. In field surveys, the target is rarely measured directly and geometric problems will cause the IP response measured to be apparent chargeability that is analogous to apparent resistivity, which is also measured in an IP survey.

In frequency-domain IP, the apparent resistivity is measured at two frequencies: F, and f which is << F. The input voltage is a square wave. The apparent resistivity is calculated and IP is expressed as the apparent frequency effect:

$$FE_{Ff} = p_{af} - p_{af} / p_{af}$$

where p_{af} is the apparent resistivity at the lower frequency and p_{aF} is the apparent resistivity at high frequency. If this ratio is expressed as a percentage change in p_a then a number called Percent Frequency Effect or PFE is used. F is in the range 1-10Hz and f is usually in the range of 0.05-0.5Hz. Another measurement of IP in the frequency domain is the metal factor (MF) where the Percentage Frequency is divided by the dc resistivity.

$$MF = PFE/p_a \times 2000$$

In SI units, the metal factor has dimensions of Siemens per metre. Metal factors are useful in exploring for massive sulphides or rocks with a significant sulphide content.

Phase domain IP can be considered as a frequency domain method or as a separate method. If a sinusoidal waveform transmitting system and a voltage receiving system are temporarily linked, the phase shift between the transmitted field and the received voltage can be measured. This phase difference, determined either in time or as a phase angle, gives the polarisation anomalies of the intervening earth in milliradians. If a number of different frequencies are utilised, a polarisation spectrum can be plotted (Pelton *et al.*, 1978; Tyne & Daggar, 1990). Most endeavours to distinguish between sources of IP are based on analysis of spectral curves.

3.2 Geophysical measurements

The objective of the study was to find a relationship between rock types and physical properties using measurements taken on diamond drill core and downhole logging. Physical properties reflect the present mineralogy of a rock unit. It is important to form a classification scheme based on present mineralogy and use it to relate physical properties such as magnetic susceptibility, conductivity, and specific gravity data to lithology, particularly when protoliths are not easily recognised in hand specimen. A relationship is then established between present mineralogy and protolith, and an inferred classification based on protolith is attempted. This proved to be difficult, as the variable metamorphic influences within the Black Swan Succession have resulted in wide ranging and inhomogeneous mineralogical assemblages, with complex distribution and composition of magnetic oxide minerals.

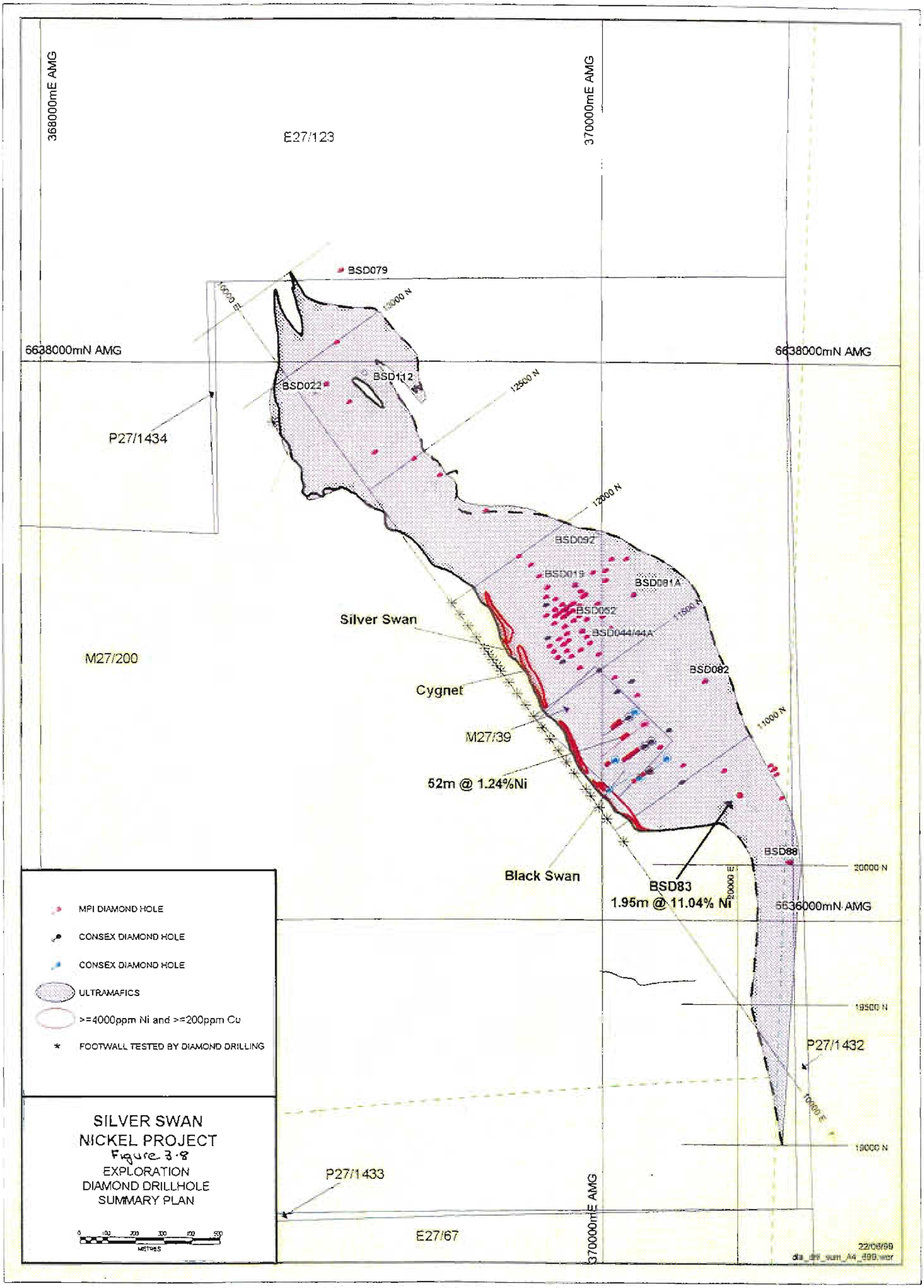
Magnetic susceptibility, specific gravity, and conductivity readings were taken on diamond core samples (refer to Appendix 3). Diamond holes and sample intervals were chosen to represent the rock types mapped by the mine geologists from a number of holes throughout the Black Swan Succession. The position of the diamond holes from which the data was collected is illustrated on a simplified geology map (Figure 3.8). Refer to Appendix 4 for details of data acquisition.

Down-hole magnetic susceptibility, inductive conductivity, resistivity and gamma–gamma measurements were made on selected intervals within diamond holes BSD44A and BSD59 (Appendices 5&6) using the OMS-LOGG system described in Appendix 4.

The diamond holes studied were chosen based on the availability of the data and position within the Black Swan Succession. BSD 44A and BSD 59 were selected as representations of the channel facies environment. BSD 86 was selected as representative of the thin flow environment, however the hole could not be re-entered by the logging tool due to obstructions downhole.

A common set of procedures was applied to all logs. To effect comparisons between sensors, all of the data was splined to a common depth increment and reference datum. The dynamic signal ranges from magnetic susceptibilities and conductivities were log 10 transformed, where indicated, to highlight the fine detail. All the logs were smoothed using a seven-point Savitzky-Golay filter. This filter moves down the hole computing weighted moving averages of the values, thus smoothing out the data and eliminating small-scale noise.

A more thorough approach would be for the mine geologist to visually log the hole with the results of the geophysical logging at hand. The mine geologist may then pay particular attention to part of the core where there are no visible changes to the naked eye, but subtle difference may be noted on closer inspection as indicated by the geophysical logs. There is no doubt that geological logging to the standard as that prepared by CSIRO are enormously valuable and should be done initially where possible, although in practice such experts are not always available. The core should however, be studied more closely after the initial evaluation.



368000mE AMG
370000mE AMG
E27/123
BSD079
10000 EL
13000 N
6638000mN AMG
6638000mN AMG
BSD112
BSD022
12500 N
P27/1434
12000 N
BSD092
BSD019
BSD081A
BSD052
11500 N
Silver Swan
BSD044/44A
M27/200
BSD082
Cygnet
11000 N
M27/39
52m @ 1.24%Ni
BSD88
Black Swan
20000 N
BSD83
1.95m @ 11.04% Ni
20000 E
6636000mN AMG
MPI DIAMOND HOLE
CONSEX DIAMOND HOLE
CONSEX DIAMOND HOLE
ULTRAMAFICS
>=4000ppm Ni and >=200ppm Cu
FOOTWALL TESTED BY DIAMOND DRILLING
19500 N
P27/1432
10000 E
19000 N
SILVER SWAN
NICKEL PROJECT
Figure 3.8
EXPLORATION
DIAMOND DRILLHOLE
SUMMARY PLAN
P27/1433
0 100 200 300 400 500
METRES
370000mE AMG
E27/67
22/06/99

3.3 Comparison of Geological and Geophysical Logging - Down Hole and on Core

OMS Logg data availability governed the selection of BSD 44A and BSD 59 (refer to figure 3.8) for studies used in an attempt to identify and correlate relationships between the petrophysical properties of the host Komatiite, its fabric and petrology.

The principal aim of the mine geologist when logging core, is to determine the protolith, the hanging wall and footwall contacts, and the presence and type of ore. However, the mine geological logs tend to represent the present mineralogy, which is influenced by alteration. The CSIRO logging protocol describes the rocks in terms of interpreted protolith, described in Komatiite volcanological terms.

Geophysical logs provide objective criteria for differentiating lithologies on the basis of compositional effects. If those compositional changes are minimal, it is possible that they will not be recognised by the geologist. Conversely, rocks that are compositionally similar but texturally distinct will not be discriminated by geophysical logging, but may be more visible to the field geologist. This is an obvious limitation of the methodology.

Interpreted volcanological CSIRO logging based on mineralogical and textural differences provided more boundaries than that of the mine geologist logging (refer to figure 3.9) and appears to correlate relatively well with the downhole geophysics (refer to figure 3.10). See Appendix 6 and 7 for geological logs.

The CSIRO geological logging documents the primary volcanological rock type that is interpreted from the present mineralogy and textures. Plots were also made of the petrophysical measurements taken on core versus Black Swan Mine and CSIRO logged rock type. The results will be described in more detail in the following chapter.

Figure 3.9

BSD 44A

Downhole Geophysics & CSIRO Logged Rock Types

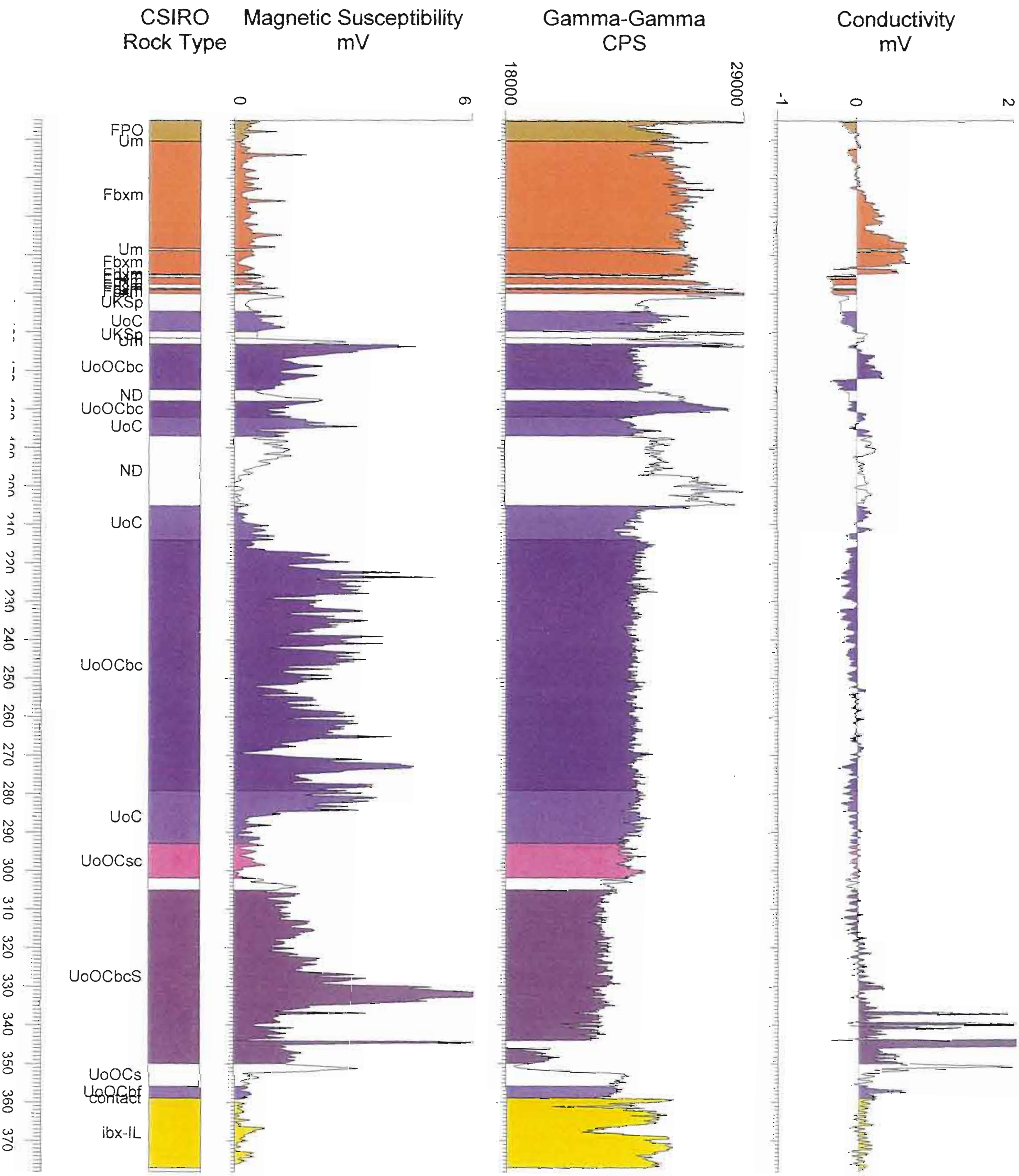
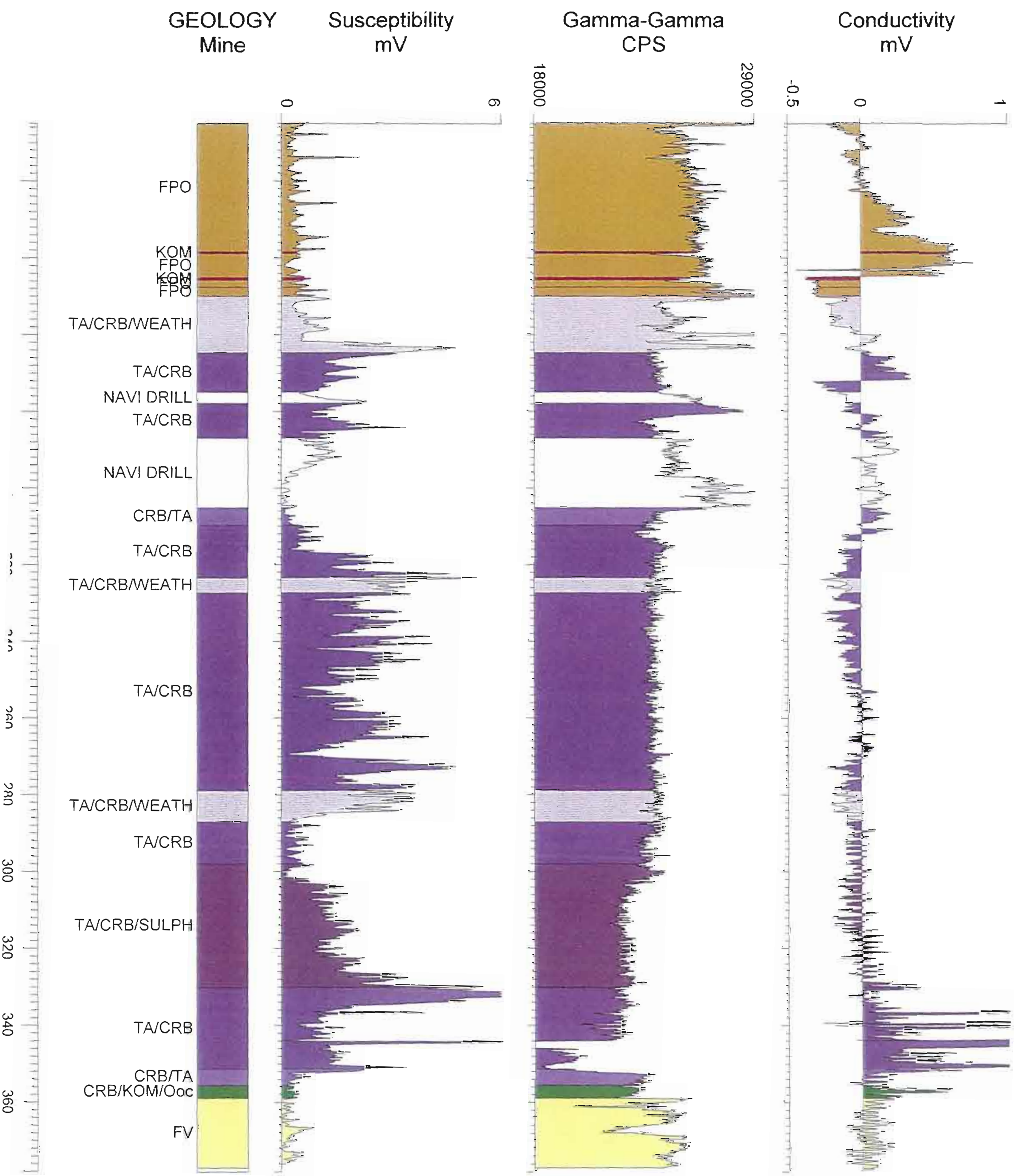


Figure 3.10

BSD 44A

Down Hole Geophysics and Mine Logged Rock Type



As a first pass evaluation the logging done by the mine geologist may be sufficient, particularly when the primary aim of the hole is to test the basal contact of the Komatiite flow. A more thorough approach would be for the mine geologist to geologically log the hole with the results of the geophysical logging at hand. The mine geologist may then pay particular attention to part of the core where there are no visible changes to the naked eye, but subtle difference may be noted on closer inspection as indicated by the geophysical logs. There is no doubt that geological logging to the standard as that prepared by CSIRO are enormously valuable and should be done initially where possible, although in practice such experts are not always available. The core should however, be studied more closely after the initial evaluation.

3.4 Petrology

An initial evaluation of the down-hole petrophysical measurements, together with geological core logging, was used as a base in choosing specimens for detailed petrographic study. The specimens chosen covered a wide range of rock types, Komatiite textures, susceptibilities, densities and conductivity. Ten centimetre long, quarter-BQ drillcore samples were cut, and thin sections were made. The representative core samples were described in terms of the geology, mineralogy and geomechanical properties. The sample suite included specimens of both ore and host lithologies.

CHAPTER FOUR

Geophysics

4.0 GEOPHYSICS

The objective was to find a relationship between rock types and physical properties using measurements taken from diamond drill core and downhole logging. Physical properties reflect the present mineralogy of a rock unit. It is important to form a classification scheme based on present mineralogy and use it to relate physical properties such as magnetic susceptibility, conductivity and specific gravity data to lithology, particularly when protoliths are not easily recognised in hand specimen. A relationship is then established between present mineralogy and protolith, and an inferred classification based on protolith is attempted. This proves to be difficult, as the variable metamorphic influences within the Black Swan Succession have resulted in wide ranging and inhomogeneous mineralogical assemblages, with complex distribution and composition of magnetic oxide minerals.

4.1 Petrophysical Measurements on Diamond Drillcore

Magnetic susceptibility, conductivity and specific gravity readings were taken of various intervals of diamond holes throughout the BSS. The intervals chosen represent rocks of varying composition, texture and metamorphic grade. As mentioned earlier, the rocks have been geologically logged in terms of present mineralogy and interpreted primary mineralogy (protolith) by the mine geologist and CSIRO respectively. The geological logs are located in Appendix 6 and 7, and the petrophysical results are tabulated in Appendix 3.

Volcanic stratigraphy was subdivided by the author into the major rock units: felsic volcanic, porphyry, ultramafic, ultramafic with disseminated sulphides, massive sulphides, and mafic intrusive.

Cross plots of the petrophysical measurements were made (Figures 4.1, 4.2 & 4.3).

Figure 4.1: Magnetic Susceptibility & Specific Gravity of Core Samples

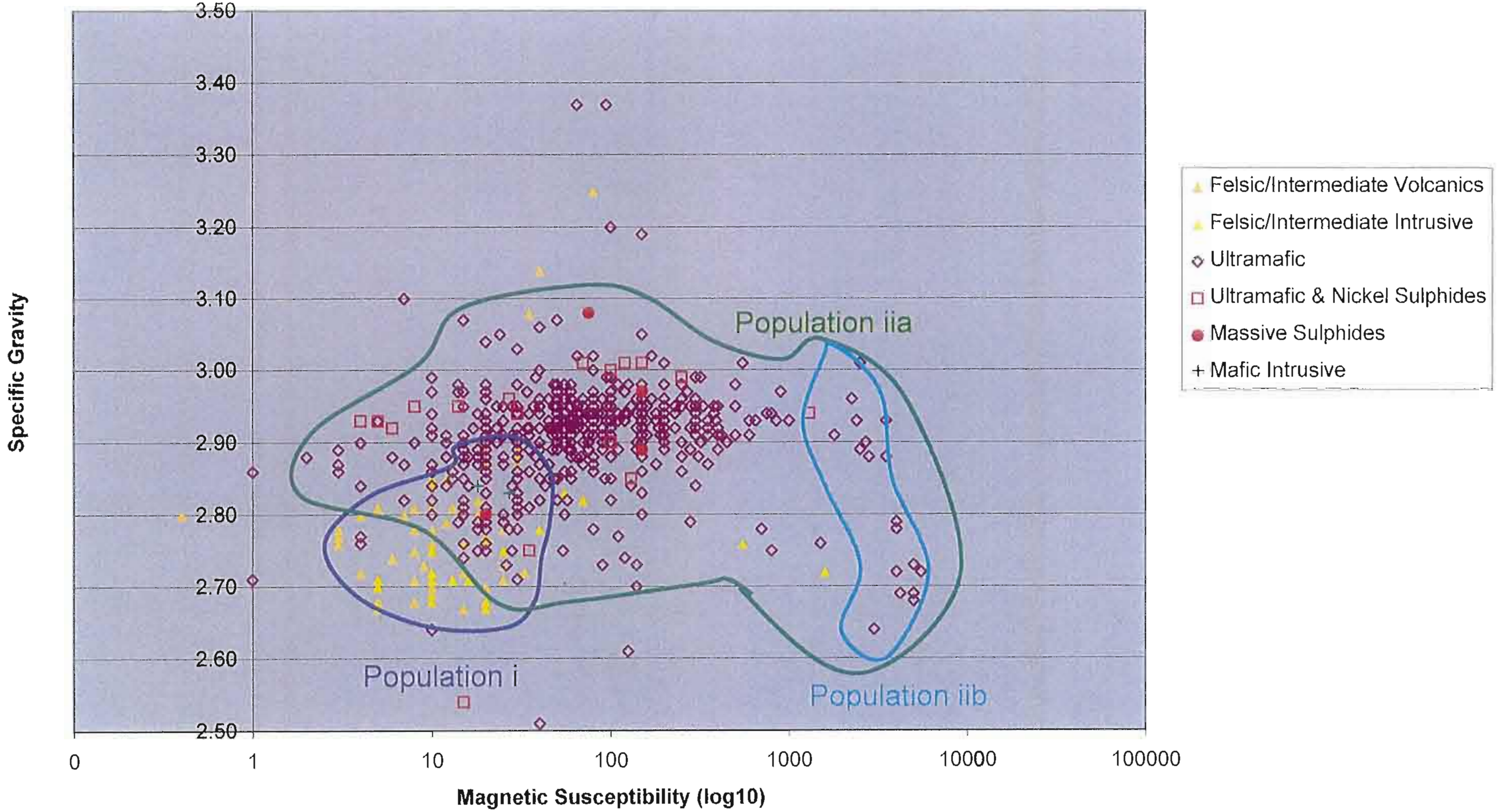


Figure 4.2: Conductivity & Magnetic Susceptibility of Core Samples

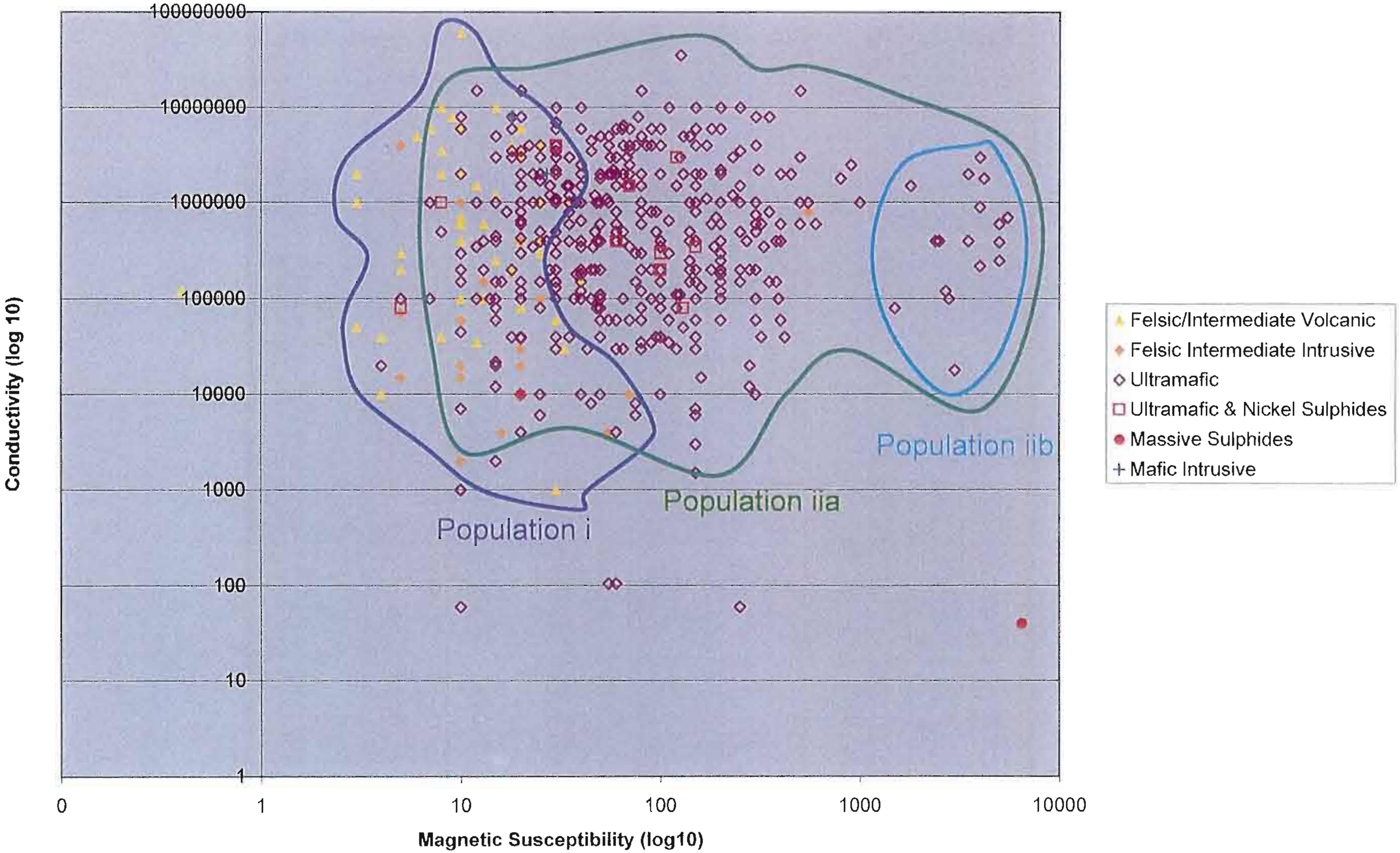
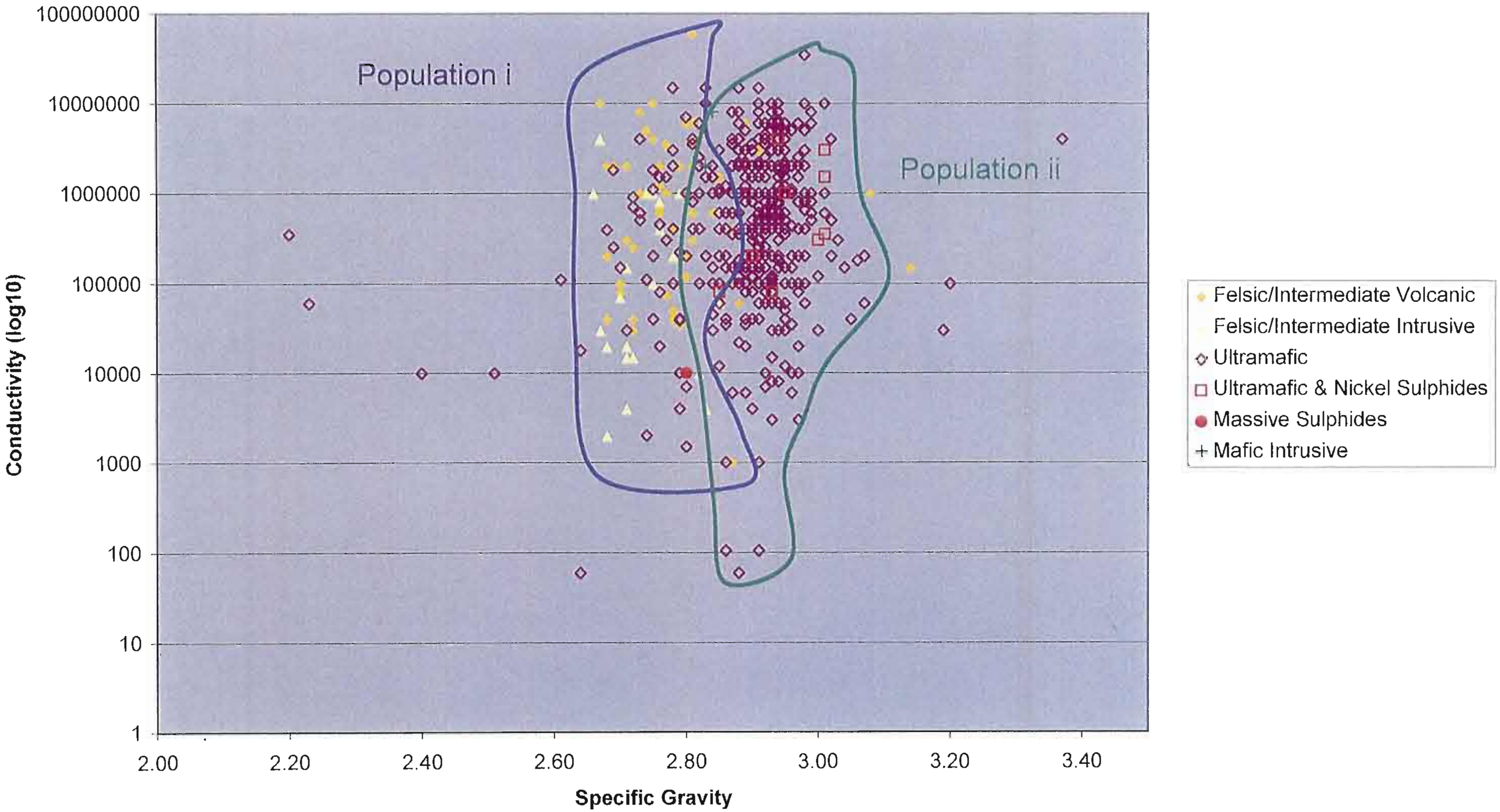


Figure 4.3: Specific Gravity and Conductivity of Core Samples



4.1.1 Magnetic Susceptibility & Specific Gravity

Two populations are evident on the cross plot between magnetic susceptibility and specific gravity which are outlined on Figure 4.1. The two populations consist of:

i - samples with a low specific gravity (2.65-2.85) and low magnetic susceptibility;
iia - medium to high specific gravity (2.7-3.10) and medium magnetic susceptibility; and,
iib- samples with high magnetic susceptibility and varying specific gravity.

4.1.2 Conductivity & Magnetic Susceptibility

Again two populations are evident on the cross plot between conductivity and magnetic susceptibility (refer to Figure 4.2). The delineating factor appears to be magnetic susceptibility.
The three populations consist of:

i – samples with low magnetic susceptibility and varying conductivity;
iia– samples with medium magnetic susceptibility; and varying conductivity; and
iiib- samples with high magnetic susceptibility and varying conductivity.

4.1.3 Specific Gravity & Conductivity

Two elongate populations can be noted on the conductivity and specific gravity cross plot. The populations can be predominantly distinguished by the specific gravity values (refer to figure 4.3). The two populations consist of
i- samples with a low specific gravity (2.65-2.85) and varying conductivity
ii - medium to high specific gravity (2.7-3.10) and varying conductivity; and,

4.1.4 Geological versus Geophysical Discussion

A general subdivision between ultramafic and felsic rocks is apparent within the above cross plots.

Two subdivisions are evident on the magnetic susceptibility / conductivity and magnetic susceptibility / specific gravity plots within the ultramafic population (Figure 4.1). The higher magnetic susceptibility population relates to the less altered serpentinite rocks as evidenced in Figure 4.4.

The felsic / intermediate intrusive rocks have the lowest magnetic susceptibility but exhibit similar conductivities to the ultramafic rocks (Figure 4.3). The rocks also appear to have a lower specific gravity then the ultramafic rock units (Figure 4.2,).

The ultramafic rocks containing disseminated nickel sulphides also demonstrate higher specific gravity than the barren ultramafic rocks (Figures 4.1 & 4.3).

4.1.5 Geophysical & Logged Geology

Magnetic susceptibility, specific gravity and conductivity measurements were also plotted against the rock types logged by the Silver Swan mine geologist (figures 4.5-4.6) and the interpreted volcanological rock types logged by CSIRO.

The CSIRO geological logging documented the primary volcanological rock type that is interpreted from the present mineralogy and textures. Plots were made of the petrophysical measurements versus CSIRO logged rock type (figures 4.7 –4.9). Two sets of plots were produced using based on the CSIRO geological logging. The first is the original CSIRO interpreted rock types and the second is a simplified version (simplified by the author) of this geological log. Table 4.1 illustrates the relationship between the two CSIRO logs. Table 4.2 represents the Black Swan Mine geological logging legend.

Table 4.3 illustrated the relationship between interpreted primary lithology (interpreted by CSIRO) versus present mineralogy (logged by the Black Swan Mine).

TABLE 4.1 Comparison between Original and Simplified CSIRO Legend

CSIRO Legend		Simplified CSIRO Legend
UKm	undifferentiated Komatiite	Ukm
UOC	undifferentiated olivine cumulate	
UKSpA2	random pyroxene spinifex textured flow	UKSp
UKSpA3	string-beef pyroxene spinifex textured flow	
UpC	pyroxene cumulate	UpC
UKSoA1	flow top - breccia olivine spinifex textured flow	UKSo
UKSoA2	random - plates olivine spinifex textured flow	
UKSoA3	books - olivine spinifex textured flow	
UoOC	olivine orthocumulate	UoOC
UopOC	olivine-pyroxene cumulate	
UoOCH	olivine orthocumulate harrisitic texture	
UoOcb	olivine orthocumulate bimodal texture	
UoOCbq	olivine orthocumulate bimodal-quench texture	
UoOCP	olivine orthocumulate platey texture	
UoOCh	olivine orthocumulate hopper texture	
UoOCw	olivine orthocumulate wormy texture	
UoOCs	olivine orthocumulate sago texture	
UoMC-AC	olivine meso-adcumulate cumulate	UoMC
UoMCs	olivine mesocumulates sago texture	
UoMCb	olivine mesocumulates bimodal texture	
$M	massive sulphide	$M
$	disseminated sulphide	$
F	felsic	F
IV	intermediate volcanic	IV
M	mafic	M

Figure 4.4: MAGNETIC SUSCEPTIBILITY & MINE ROCK TYPE

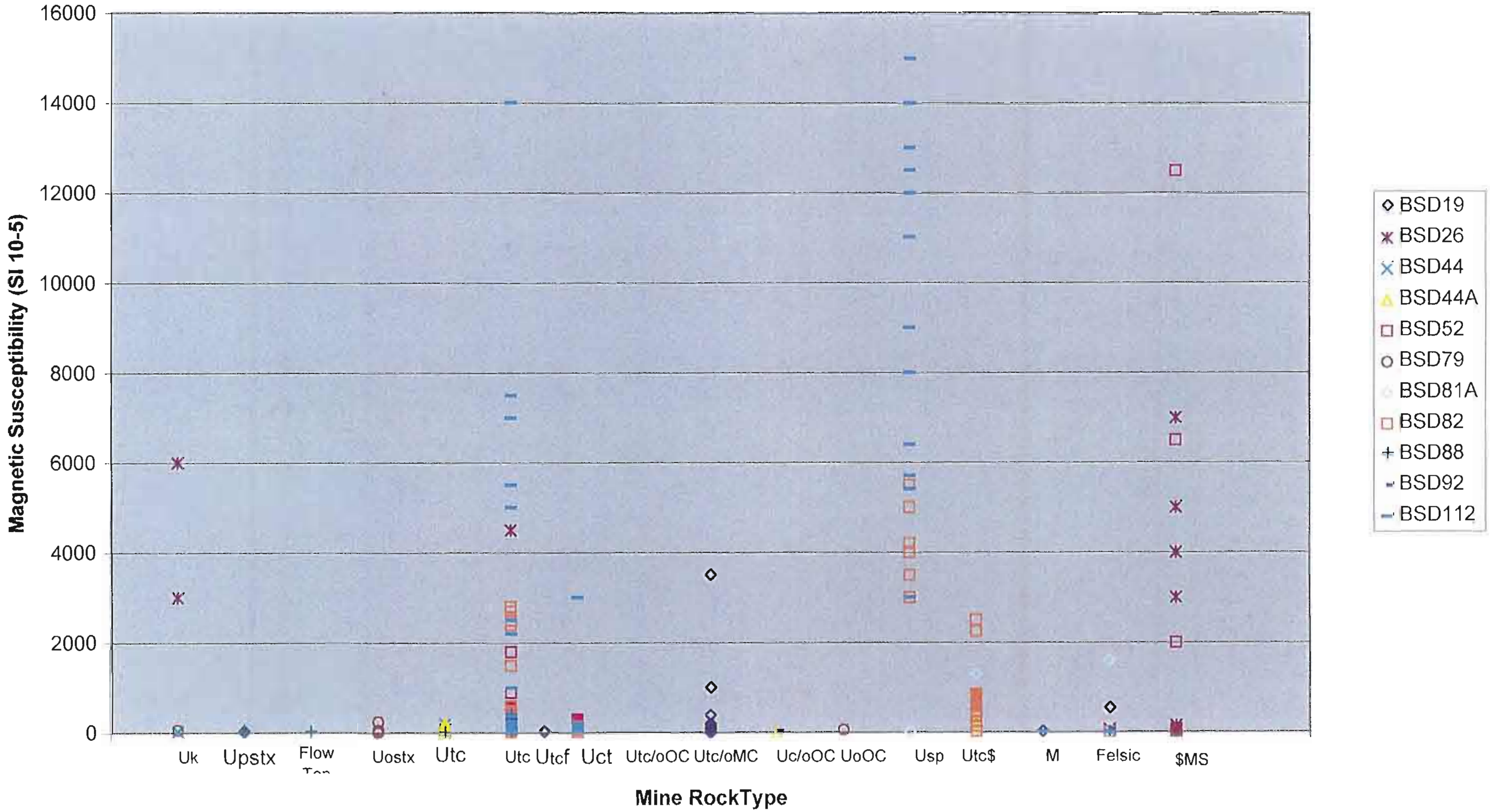


Figure 4.5: SPECIFIC GRAVITY & MINE ROCK TYPE

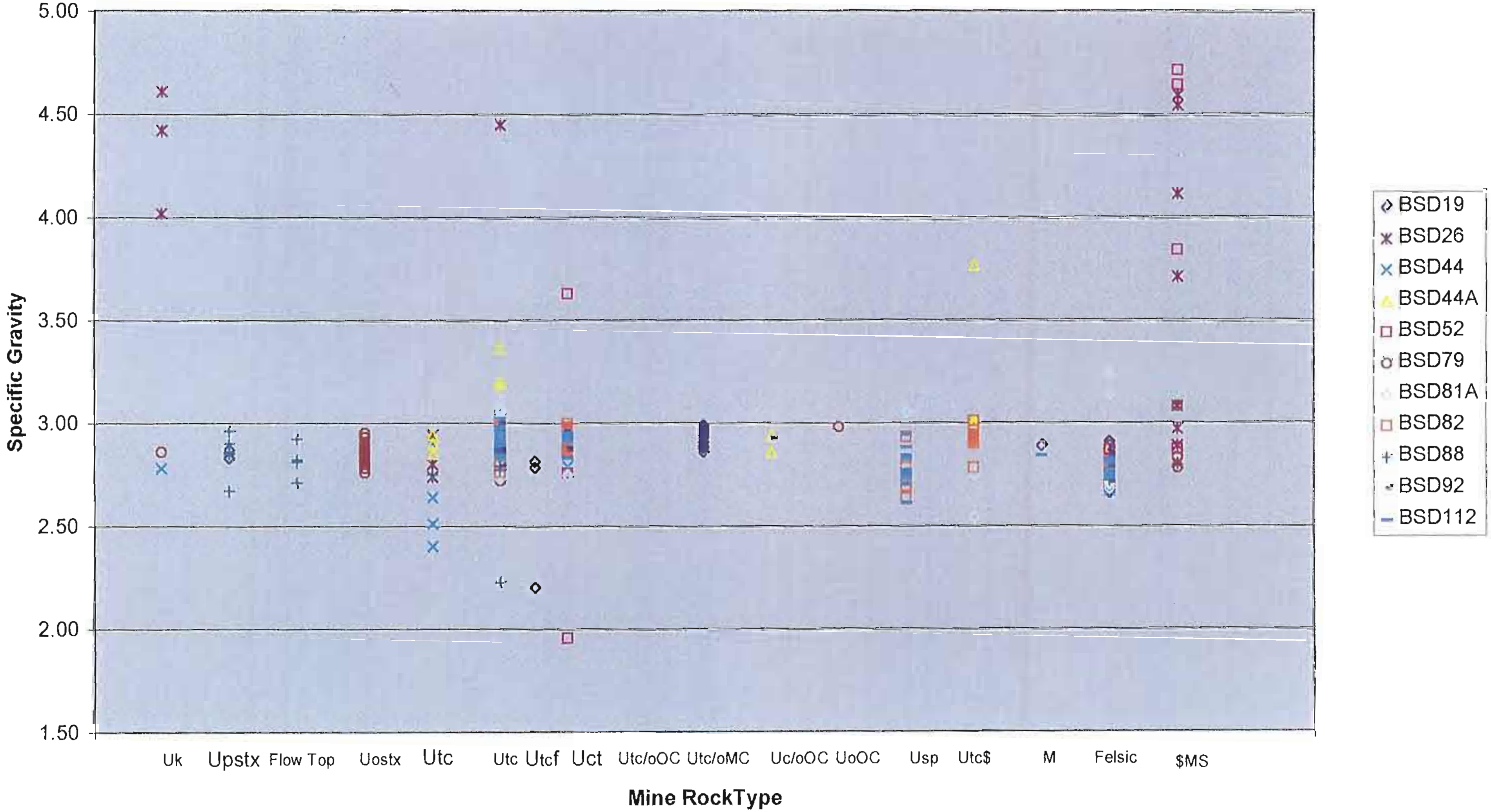


Figure 4.6: CONDUCTIVITY & MINE ROCK TYPE

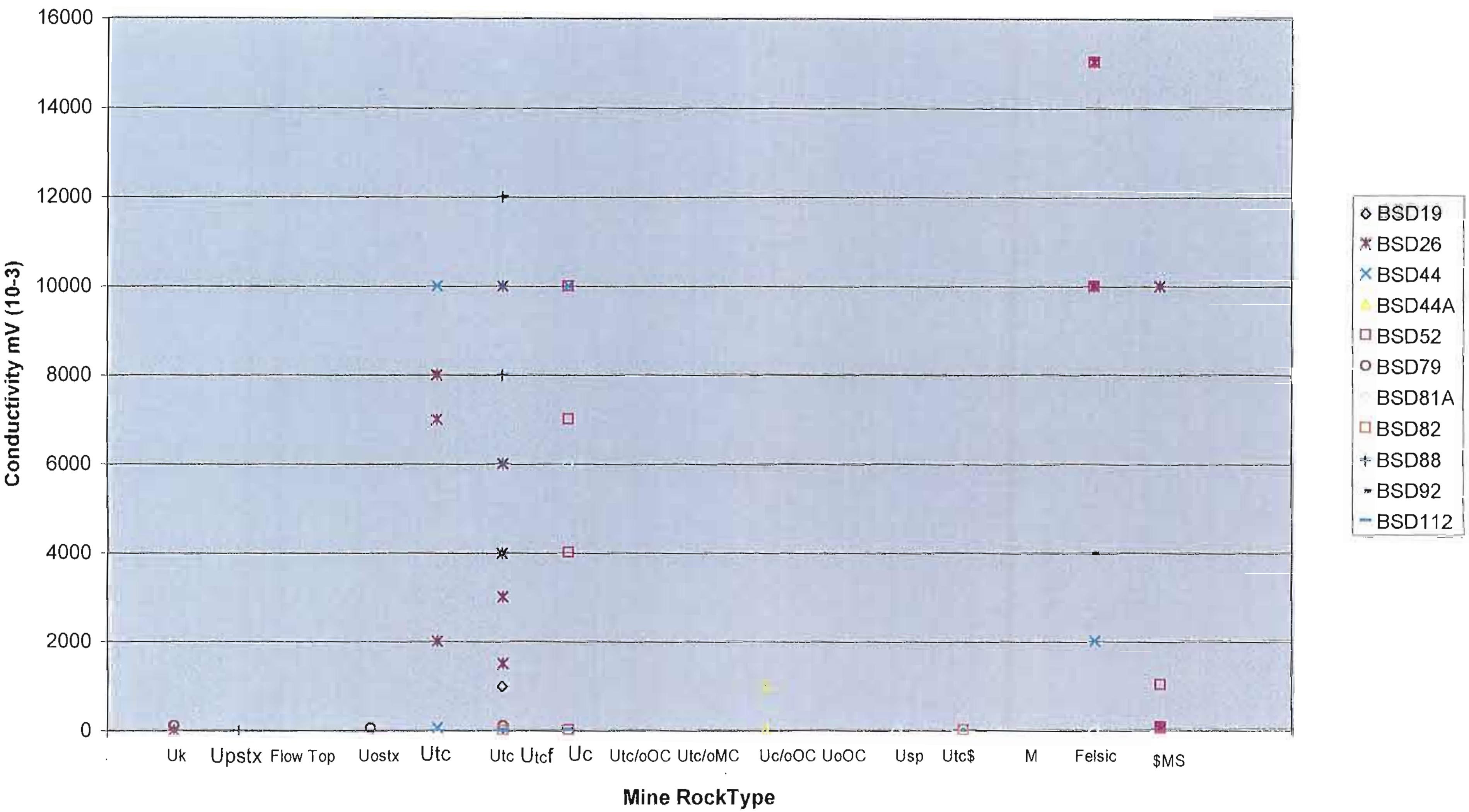


Figure 4.7a : MAGNETIC SUSCEPTIBILITY & CSIRO ROCK TYPE

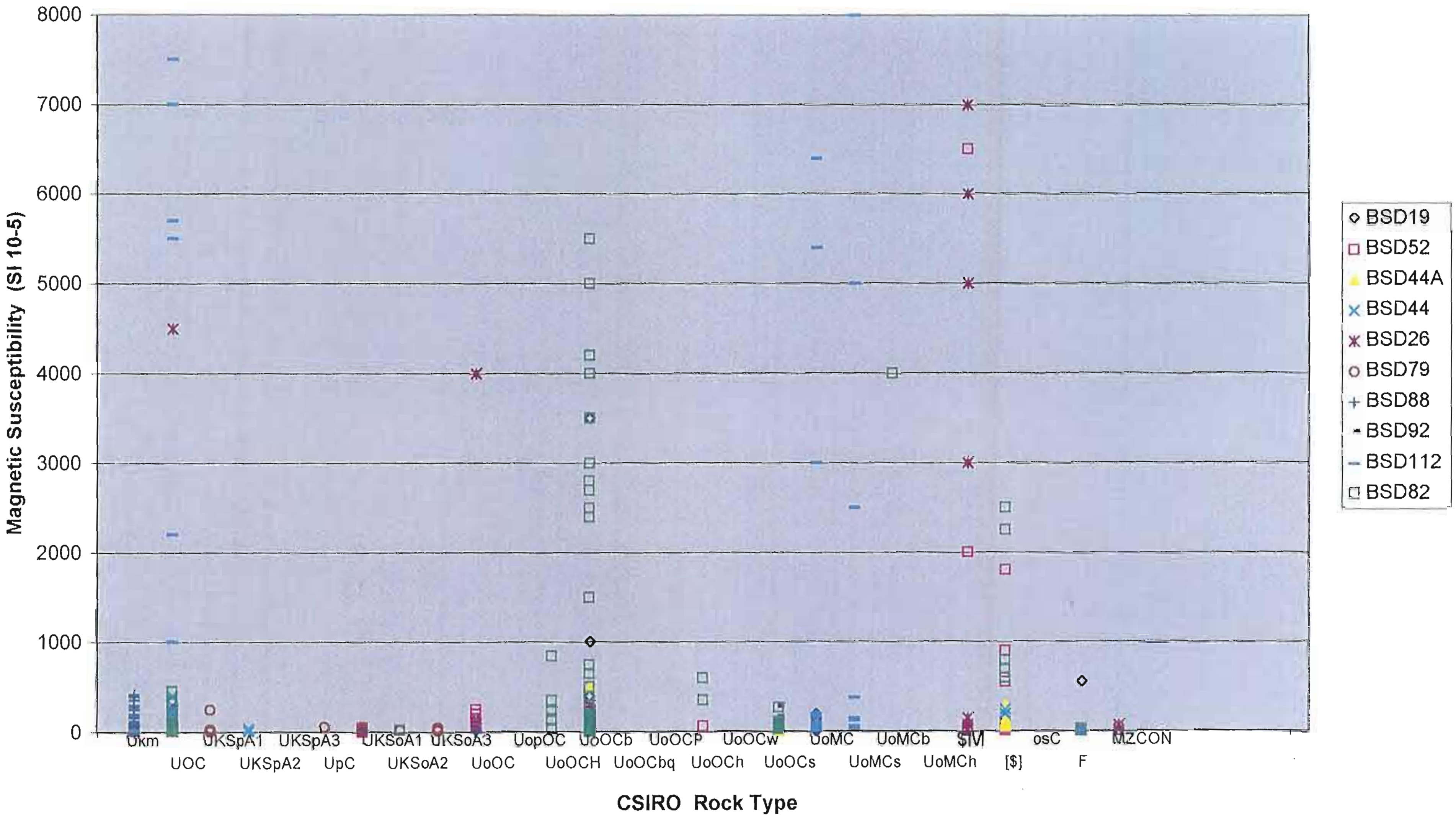


Figure 4.7b: MAGNETIC SUSCEPTIBILITY & CSIRO SIMPLIFIED ROCK TYPE

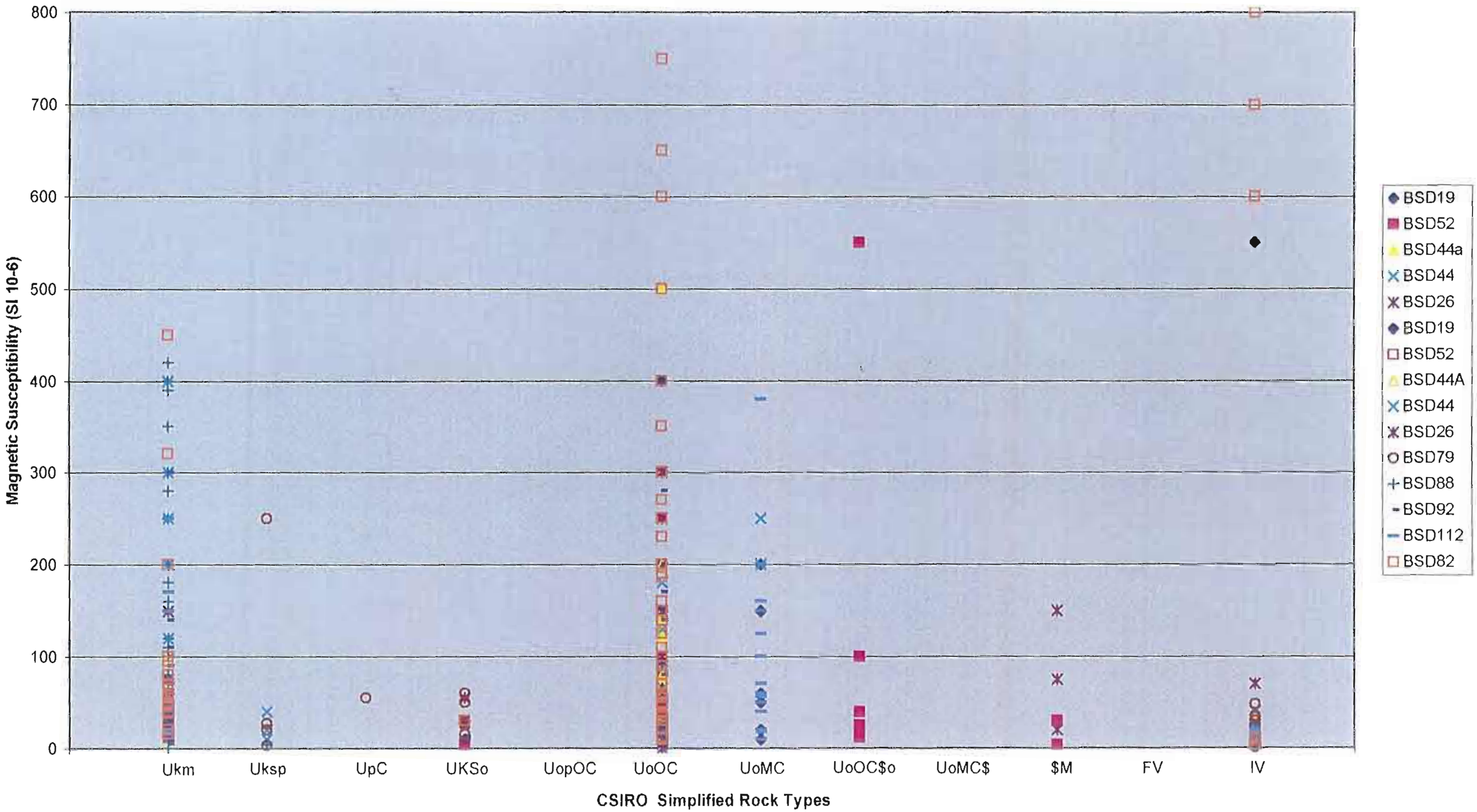


Figure 4.8a : SPECIFIC GRAVITY & CSIRO ROCK TYPE

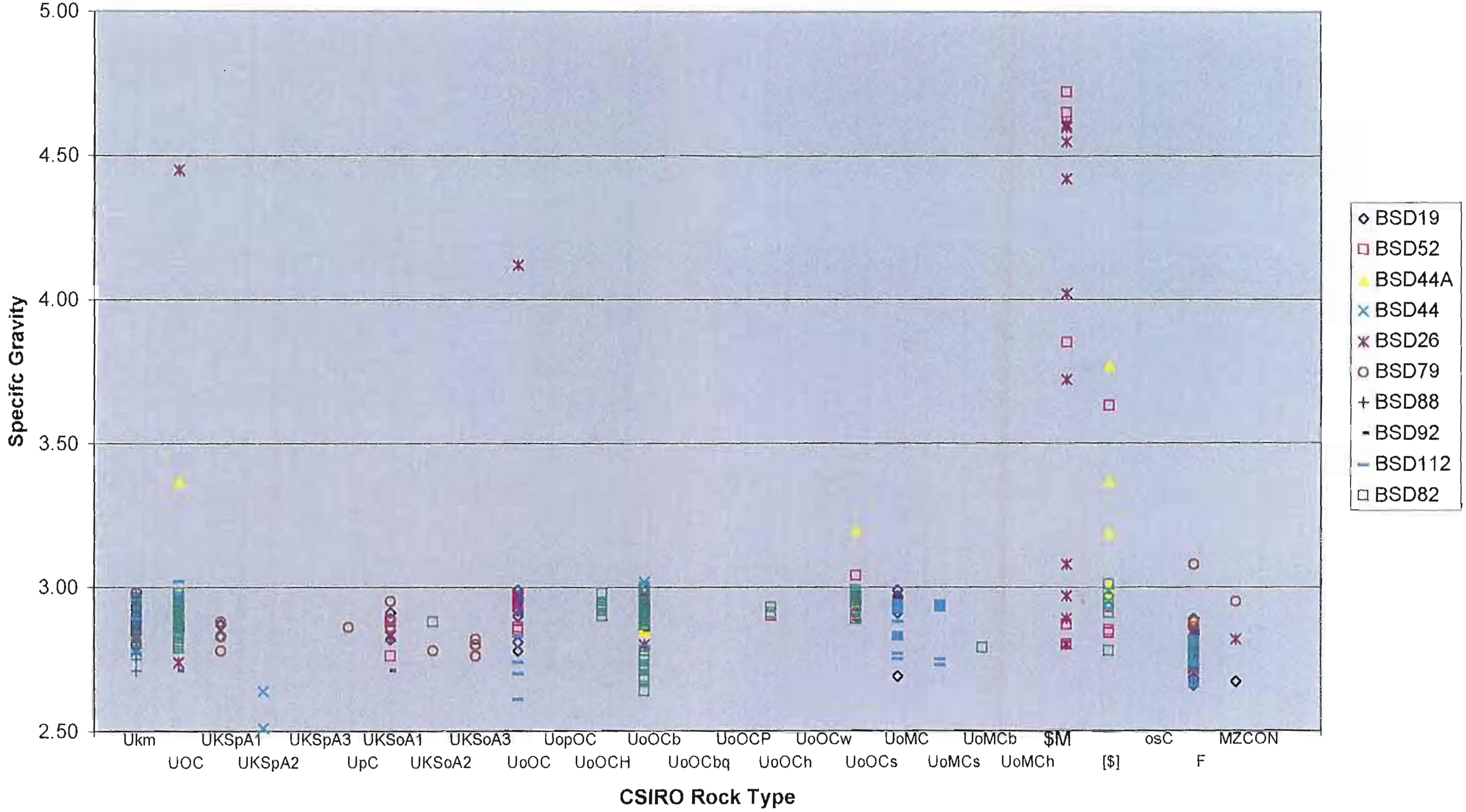


Figure 4.8b: SPECIFIC GRAVITY & CSIRO SIMPLIFIED ROCK TYPE

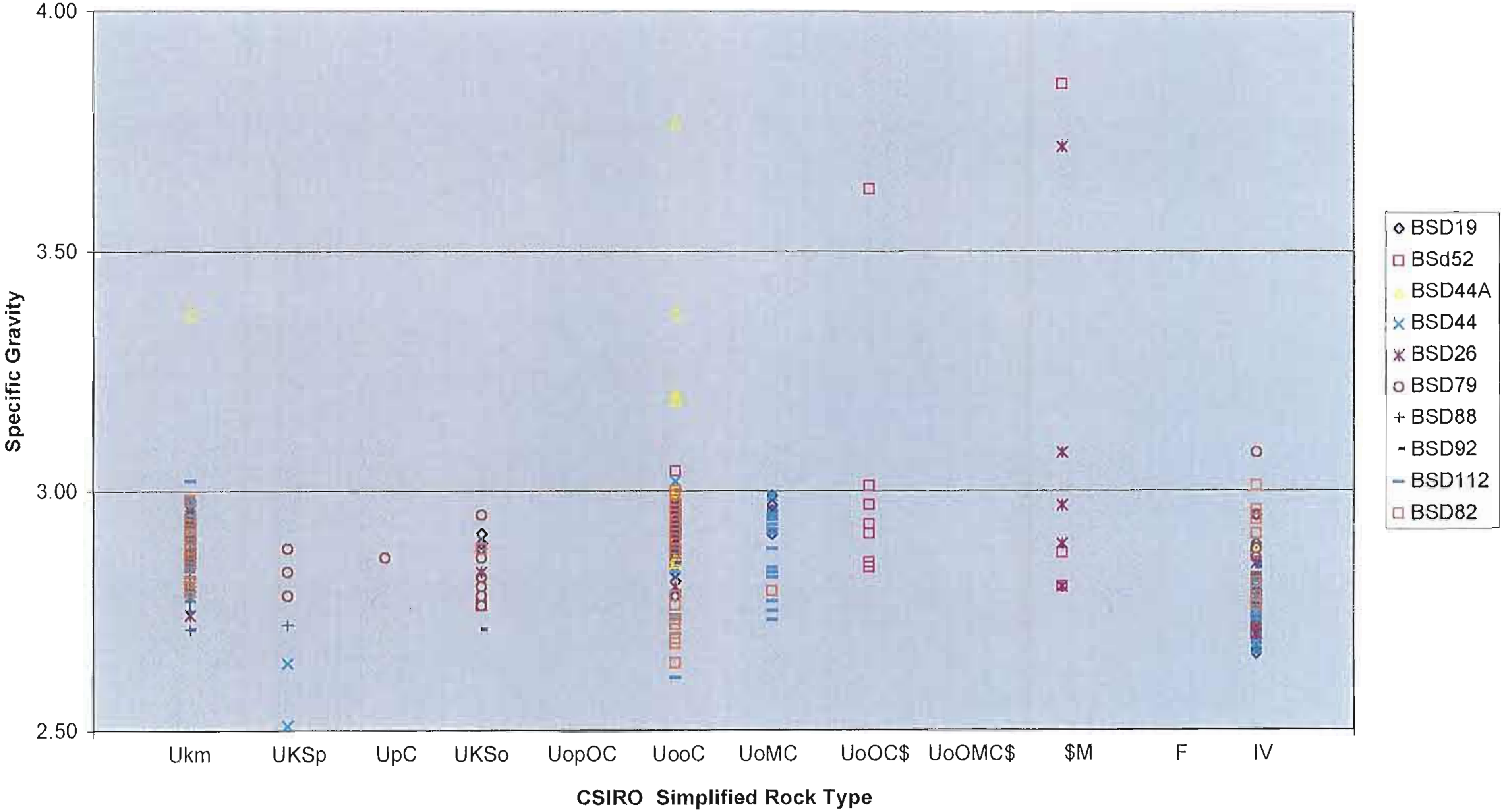


Figure 4.9a : CONDUCTIVITY & CSIRO ROCK TYPE

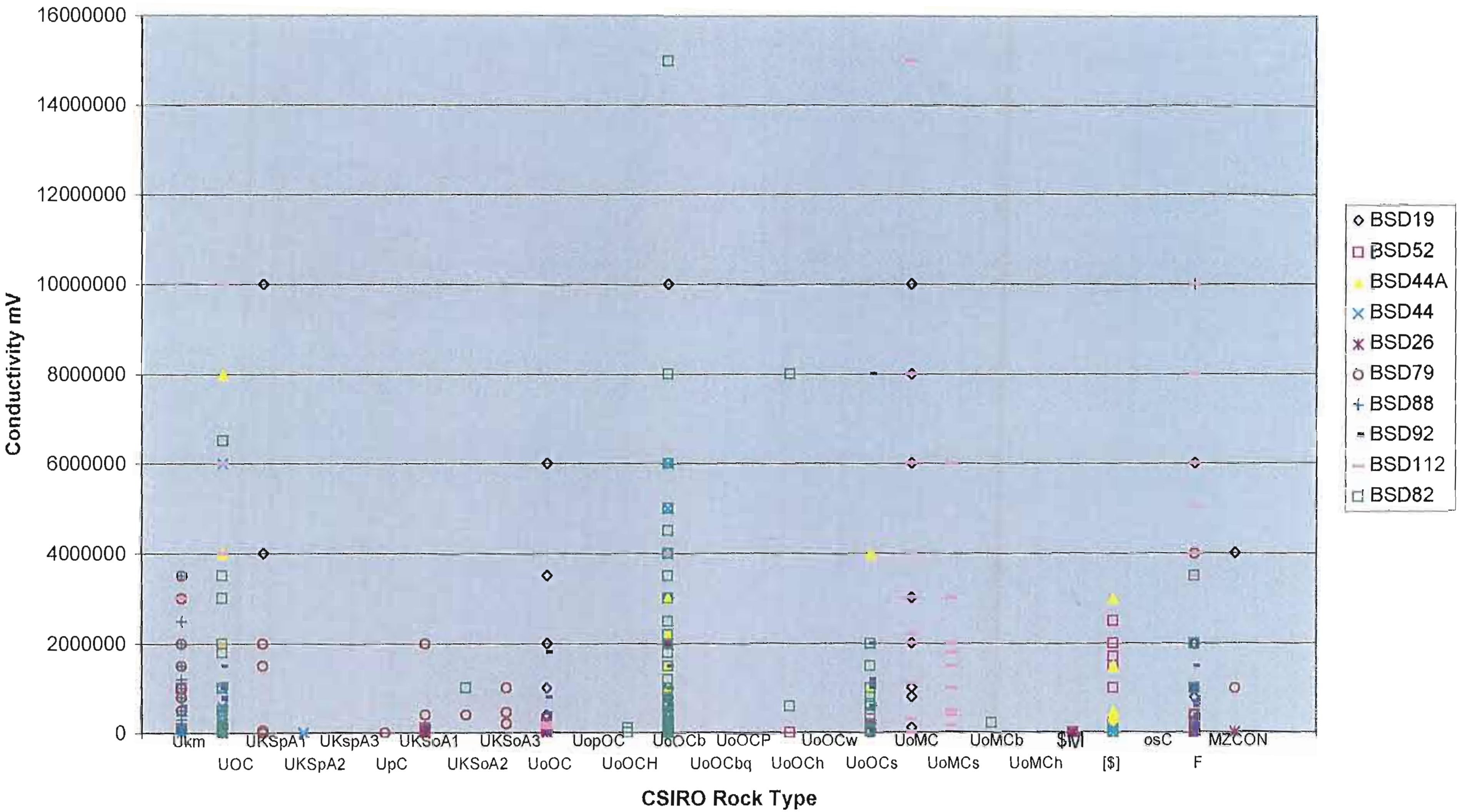


Figure 4.9b: CONDUCTIVITY & CSIRO SIMPLIFIED ROCK TYPE

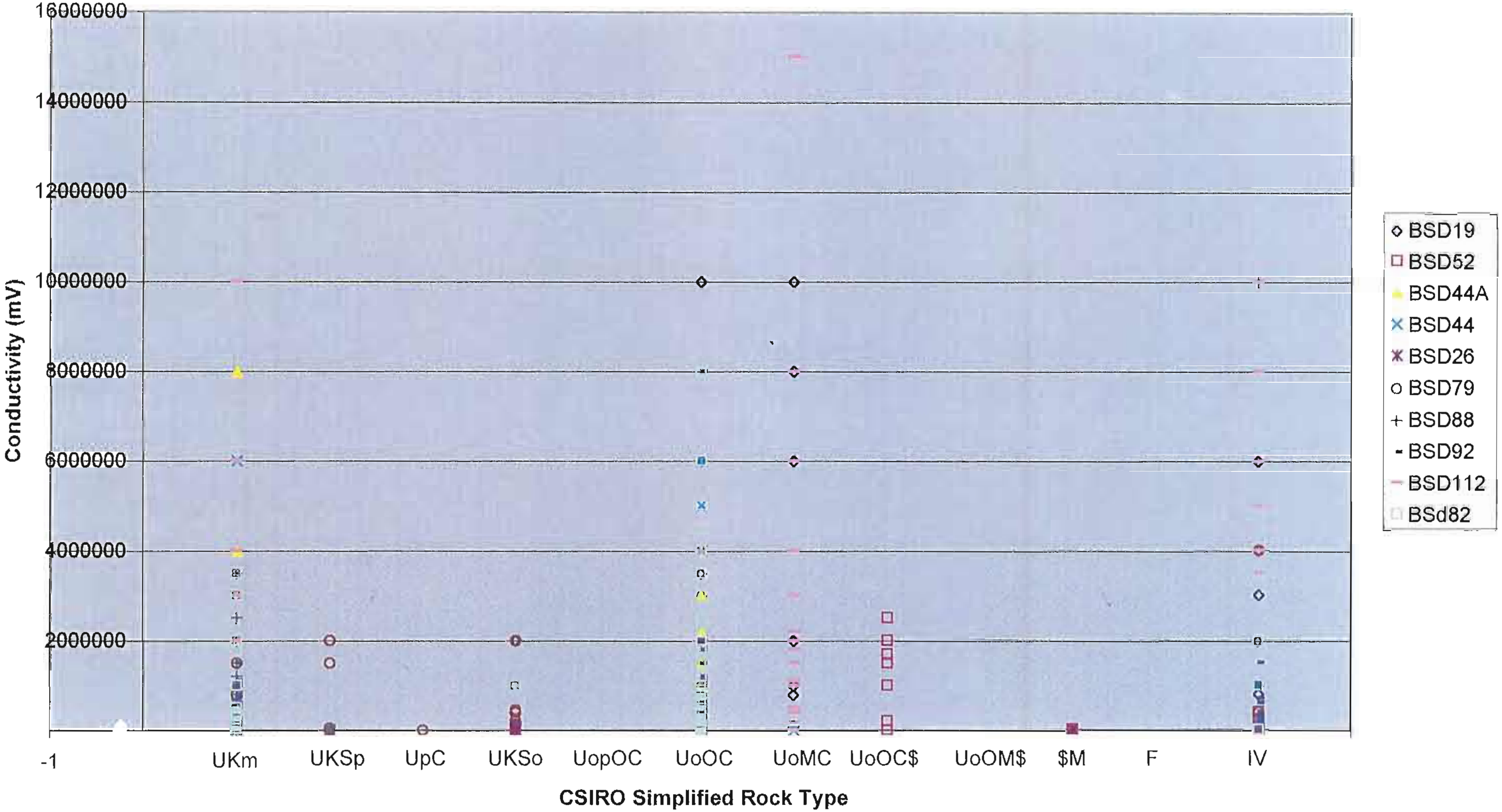


Table 4.2 Black Swan Mine Legend

Black Swan Mine Legend	
Uk	undifferentiated Komatiite
Upstx	pyroxene spinifex
Flow top	flow top- olivine spinifex textured flow
Uostx	olivine spinifex textured flow
Utcw	weathered talc carbonate ultramafic
Utc	talc carbonate ultramafic
Utcf	ferruginous talc carbonate ultramafic
Uct	carbonate ultramafic
Utc/oOC	talc carbonate ultramafic exhibiting olivine orthocumulate textures
Utc/oMC	talc carbonate ultramafic exhibiting olivine mesocumulate textures
Uc/oOC	carbonated ultramafic exhibiting olivine orthocumulate textures
Usp	Serpentinite
Utc$	talc carbonate ultramafic with disseminated sulphides
$MS	massive sulphide
Felsic	felsic rock
M	mafic rock

Table 4.3 Interpreted Primary Lithology (CSIRO) versus Present Mineralogy (Black Swan Mine)

Interpreted Primary Lithology (CSIRO)	**Metamorphic *Present* Mineralogy (Black Swan Mine)**
UKM	Ukm
UoOC*	Utcw, Utc, Utc/oOC, Uc/oOC
UoMC	Utc/oMC, Usp
$	Utc$
$M	$MS
F	Felsic
M	M

A number of plots were produced in an attempt to find some correlation between the rock types and their physical properties. The following observations have been drawn from the plots.

4.1.6 Magnetic Susceptibility & Logged Mine Geology

When magnetic susceptibility data was plotted against the geological logs, a number of broad lithological relationships were observed (refer Figure 4.4).

As expected serpentinites exhibited the highest and widest range of susceptibility. Talc carbonate rocks showed varying susceptibilities, which varied qualitatively from low to medium.

The massive sulphide samples also exhibited a range of susceptibilities from low to medium, with the exception of one high reading.

The olivine spinifex, pyroxene spinifex and felsic rocks showed relatively low susceptibility over a restricted range. However, the ranges for the rock types were similar and hence could not be used for identification.

4.1.7 Specific Gravity & Logged Mine Geology

All rock types appear to exhibit overlapping specific gravity ranges. The massive sulphides showed the greatest variation in specific gravity hence density. The talc carbonate rocks demonstrate some of the lowest values (refer Figure 4.5).

4.1.8 Conductivity & Logged Mine Geology

No correlation between lithology and conductivity was observed. Unexpectedly, the weathered ferruginised, and normal talc carbonate rocks, showed a wide range of conductivity values from low to high. The felsic rocks and the massive sulphides also exhibited high values (refer to Figure 4.6).

4.1.9 Magnetic Susceptibility & CSIRO Logged Geology

There was found to be little difference in the magnetic susceptibility ranges of the olivine meso-adcumulate, with or without disseminated sulphides, and the undifferentiated olivine cumulate rocks. These rocks show the greatest variation in values. The spinifex-textured flow rocks have low magnetic susceptibilities in comparison to their cumulate counterparts (refer Figure 4.7a & 4.7b).

4.1.10 Specific Gravity & CSIRO Logged Geology

The massive sulphide rocks demonstrate the greatest range in specific gravity, followed by the rocks containing disseminated nickel sulphides. A2 olivine spinifex-textured flow rocks have the lowest specific gravity. The sago-textured olivine orthocumulate shows the highest range amongst the sulphide barren ultramafic rocks (refer Figure 4.8a & 4.8b). The rock types exhibit defined ranges in specific gravity, however these ranges tend to overlap.

4.1.11 Conductivity & CSIRO Logged Geology

The highest conductivity value for a number of the rock types is 10,000,000mV, which is obviously the upper detection limit of the measuring instrument. With this fact in mind, spinifex-textured flow rocks exhibit the lowest conductivities. Olivine cumulates and felsic rocks have varying conductivity ranges (refer Figure 4.9a & 4.9b).

4.1.12 Discussion

A general subdivision between ultramafic and felsic rocks is apparent in the above crossplots.

The felsic / intermediate intrusive rocks have the lowest magnetic susceptibility, exhibit similar conductivities to the ultramafic rocks, but are less dense (i.e. display lower specific gravities).

As expected the serpentinites exhibited the highest susceptibility, and the greatest range. Serpentinisation usually creates substantial quantities of magnetite (pure & Cr-magnetite), accounting for the high susceptibility of serpentinised ultramafic rocks. The pure magnetite is generally multidomain, well-crystallised, almost pure Fe_3O_4, which is magnetically soft and carries relatively weak remanence ($Q_n<1$). Initially, pure magnetite and Cr-magnetite produced during serpentinisation incorporate progressively more Cr. Prograde metamorphism (amphibolite facies) of serpentinised ultramafics causes increasing substitution of Mg and Al into the magnetite, eventually shifting the composition into the paramagnetic field. Thus, metamorphism progressively demagnetises serpentinites causing the less altered serpentinite rocks exhibit higher magnetic susceptibilities. The effect of metamorphism on magnetic susceptibility is illustrated in figure 4.10.

Spinifex-textured flow rocks have low magnetic susceptibilities in comparison to their cumulate counterparts. Talc carbonate rocks show varying susceptibilities, which varied qualitatively from low to medium. The massive sulphide samples also exhibit a range of susceptibilities from low to medium, with the exception of one high reading.

All rock types appear to exhibit overlapping specific gravity ranges. The massive sulphides show the greatest variation in specific gravity, hence density.

Density is controlled by three factors: the grain density of minerals forming the mass, the porosity and the fluid in the pore space (Emerson, 1990). Therefore, as metamorphism effects the mineral composition it will also affect density. Data collected by Bourne (1992) from ultramafics sourced from greenstone belts in the Yilgarn Craton (Western Australia) - which have undergone Greenschist and Amphibolite facies metamorphism - shows an increase in mean density of $0.2 g/cm^3$ with increasing metamorphic grade

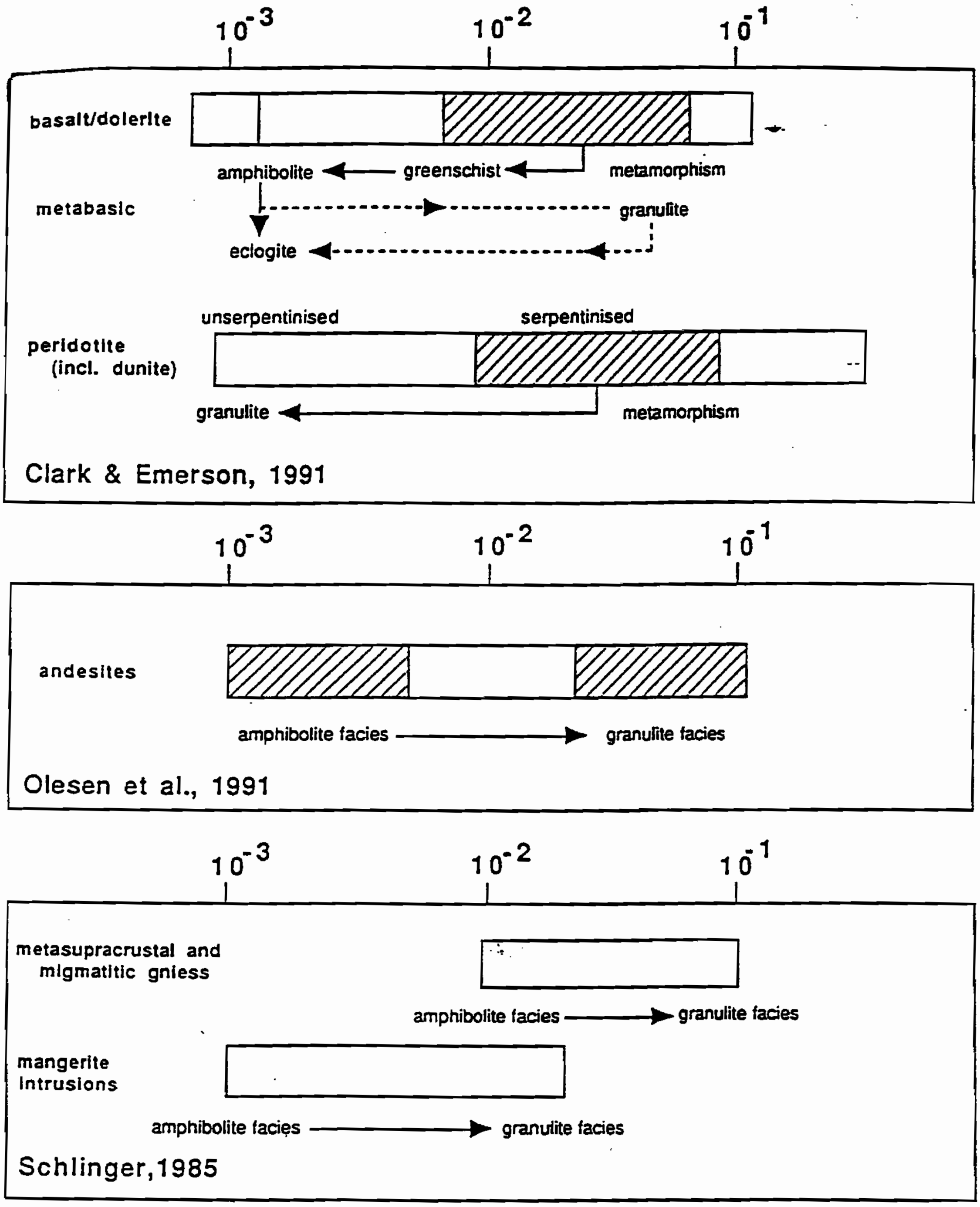


Figure 4.10 Examples of the effect of metamorphism on the magnetic susceptibility (S.I.) of different rock types. Bars represent total ranges. Hatched areas indicate dominant values. (From Bourne, 1992.)

(figure 4.11). Page (1967), Coleman (1971), Burch (1968) and others have determined that a relationship often exists between density and the degree of serpentinisation. Thus, the increased density of ultramafic rocks from greenschist to amphibolite facies results from replacement of serpentine/talc (2.7g/cm^3) by olivine (3.3 g/cm$_3$). Also, due to the high density of magnetite (5.2g/cm^3), changes in magnetite content may affect the density. Olsen *et al.* (1991) and Henkel (1976) have also noted magnetite distribution affecting the density of similar rock types. This observation is the most probable cause for the olivine spinifex-textured flow rocks exhibiting the lowest densities.

The ultramafic rocks containing disseminated nickel sulphides also demonstrate higher specific gravity then the barren ultramafic rocks due to the dense nature of the sulphides.

4.2 Down Hole Petrophysical Measurements

Interpreting downhole geophysical logs into useful geological units presents a major challenge. Several different approaches have been attempted to resolve this problem. In this study two simple approaches were used:
An intuitive "eyeball approach" - in which contacts were visually selected on the basis of a sharp change in physical property levels. Contacts having sequentially lower amplitude were selected until there was a complete loss of confidence in the existence of further subdivisions.

Statistical cross correlation, using cross plots of multiple variables was also attempted. OHMS Logg data collected from diamond drill hole BSD 44A was studied in detail. The results are documented below.

4.2.1 Intuitive Approach

Using the intuitive approach some geological contacts were obvious, particularly those bounding the ore. The geophysical logs and the interpreted geological contact by the author are presented in Figure 4.12.

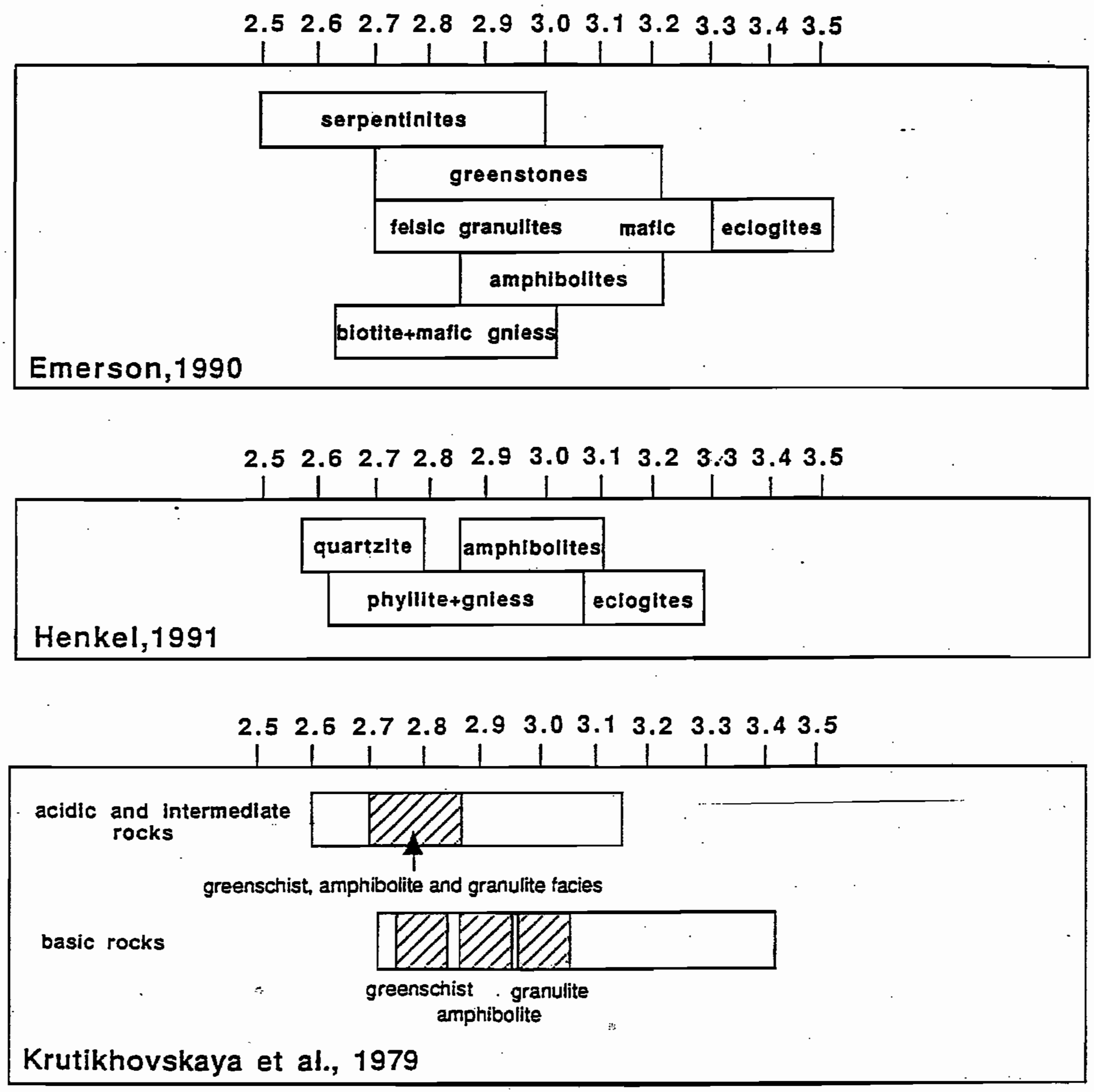
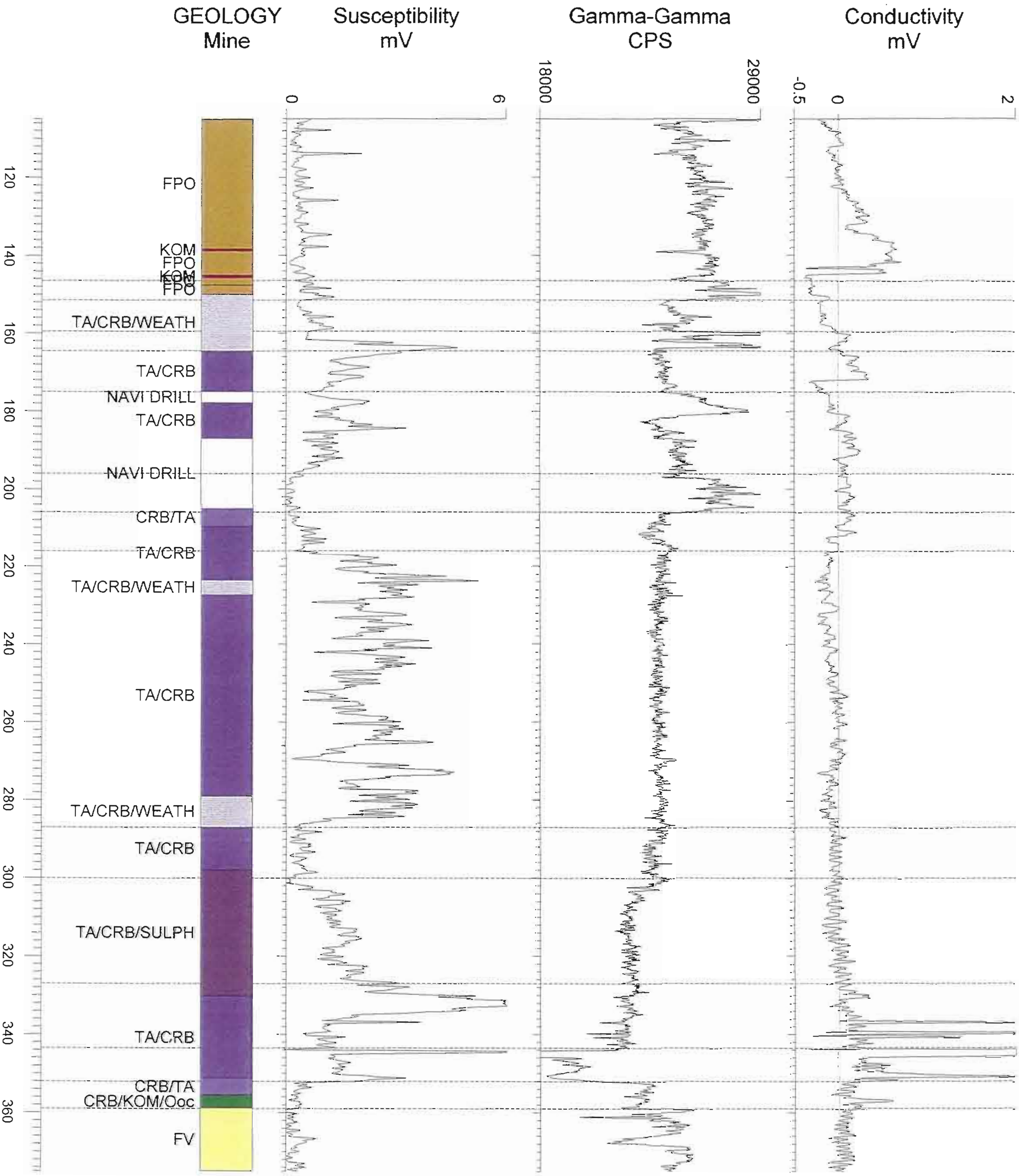


Figure 4.11 Examples of the effect of metamorphism on the densities of different rock types. The bars represent total ranges and the hatched areas represent usual ranges.

Figure 4.12

BSD 44A

Interpreted Geophysical Divisions



4.2.2 Statistical Cross Correlation

Cross plots of magnetic susceptibility, conductivity, and gamma-gamma were made and results are discussed below.

4.2.2.1 Conductivity and Magnetic Susceptibility

The cross plot between conductivity and magnetic susceptibility (refer to Figure 4.13) demonstrates the majority of the readings grossly fit within a defined group. However, a minority of the results displays varying conductivities.

4.2.2.2 Conductivity and Gamma-Gamma

Three populations, differing in gamma-gamma values is observed in the plot of conductivity and gamma-gamma (refer Figure 4.14).

4.2.3.3 Magnetic Susceptibility and Gamma-Gamma

Figure 4.15a is a plot of gamma-gamma and magnetic susceptibility. This combination has proven to be more discriminatory in nature. Seven relatively separate populations are evident.

Population A displays lower gamma-gamma values. *Population B* has higher gamma-gamma values and can be differentiated from *Population C* by a difference in magnetic susceptibility. *Population D* displays a wide range of magnetic susceptibilities and a relatively discrete range of gamma-gamma values. *Populations E and F* display lower magnetic susceptibilities (see figure 4.15b) than *Population D* but appear to have differing gamma-gamma median. *Population G* has higher Gamma-gamma readings than *Populations E and F*.

Figure 4.13
BSD 44A Downhole Conductivity and Magnetic Susceptibility

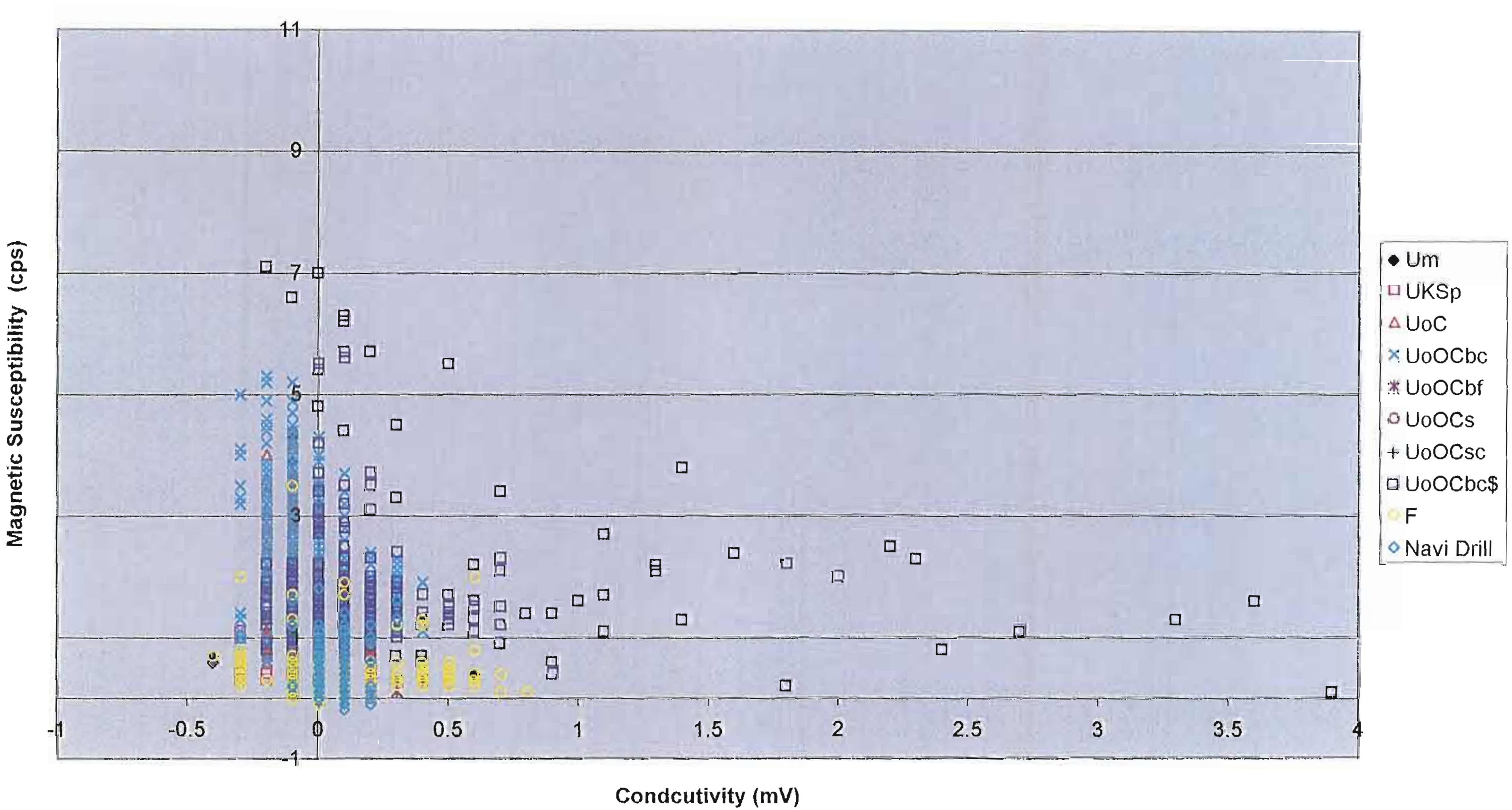


Figure 4.14
BSD 44A Downhole Gamma-Gamma and Conductivity

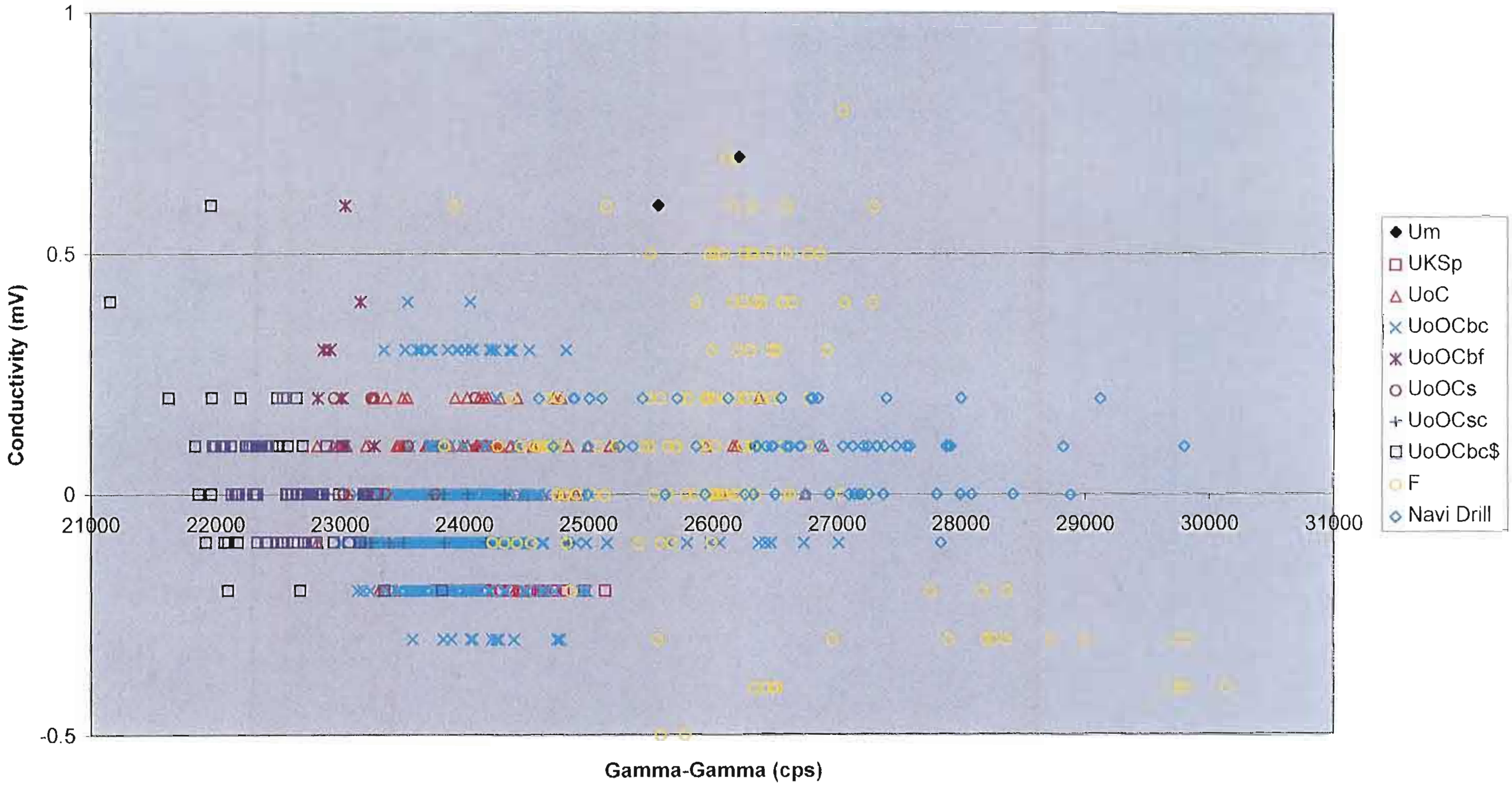


Figure 4.15a
BSD 44A Downhole Gamma-Gamma and Magnetic Susceptibility

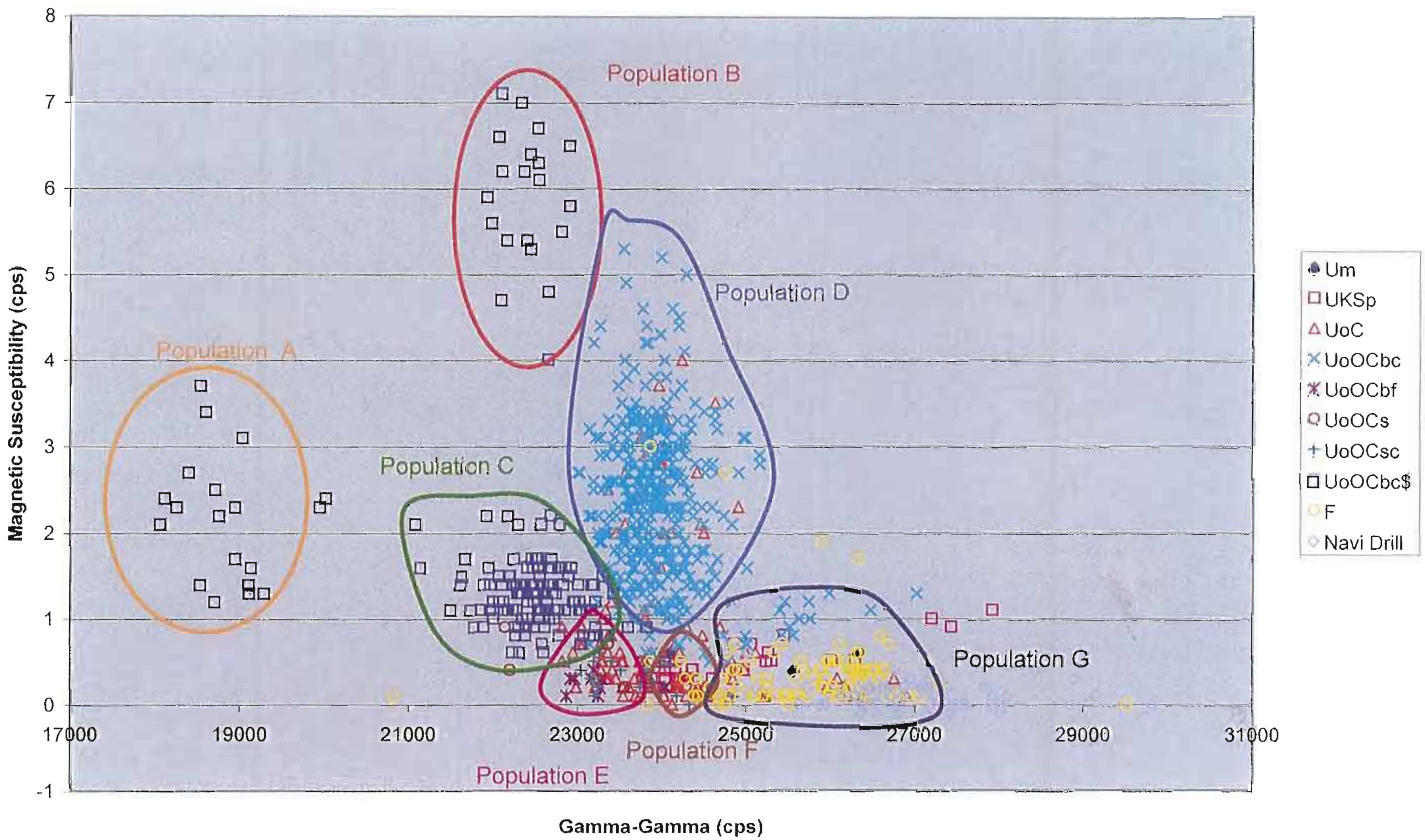
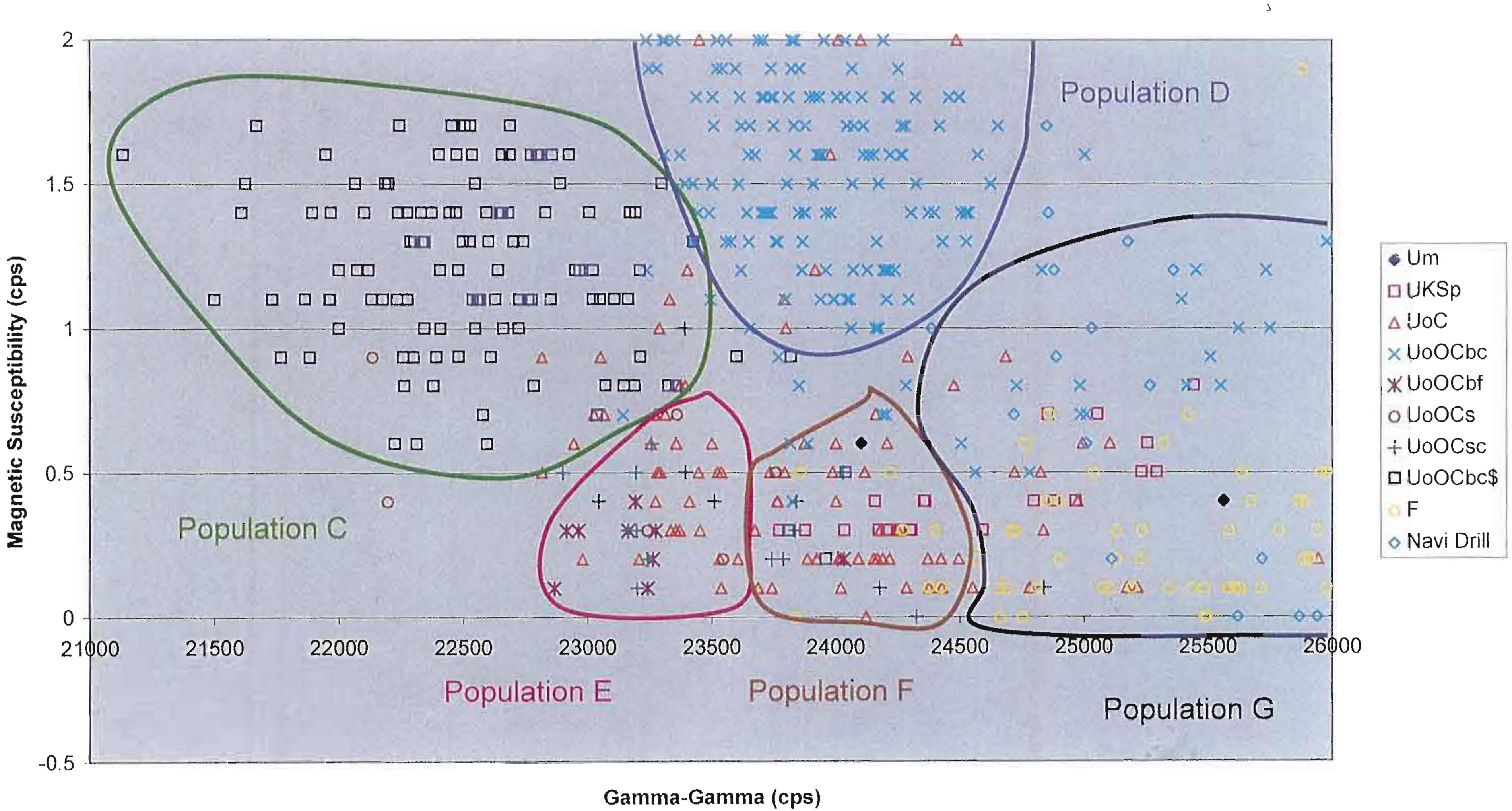


Figure 4.15b
BSD 44A Downhole Gamma-Gamma and Magnetic Susceptibility



4.3 Geophysical Versus Geological

A comparison between the geological mine logs and the geophysical logs was made to determine the validity of geophysically determined contacts. In the broad sense, the contacts between felsic volcanic rocks and ultramafic rocks were matched. Figures 4.16a and 4.16b show these relationships at a smaller scale with a greater number of subdivisions. This allows for easier viewing of the interpreted geophysical subdivisions.

Geophysical logs provide objective criteria for differentiating lithologies on the basis of compositional effects. If those compositional changes are minimal, it is possible that they will not be recognised by the geologist. Conversely, rocks that are compositionally similar, but texturally distinct will not be discriminated by geophysical logging, but may be more visible to the field geologist. This is an obvious limitation of the methodology. Interpreted volcanological CSIRO logging based on mineralogical and textural differences provided more boundaries than that of the mine geologist logging and appeared to correlate relatively well with the downhole geophysics (Refer to figure 4.17a & 4.17b).

4.4 Discussion

4.4.1 Intuitive Approach/ BSD44A sections

A review of each of the interpreted geophysical boundaries delineated by their depths follows. Figures 4.16a, b & 4.17a, b. show the geophysically interpreted unit boundaries against the mine geologically logged boundaries and the CSIRO geological logs.

The discussion below relates to observations in Figures 4.16a, b & 4.17a, b.

Figure 4.16a

BSD 44A

Interpreted GeophysicalSubdivisions (100-200m)

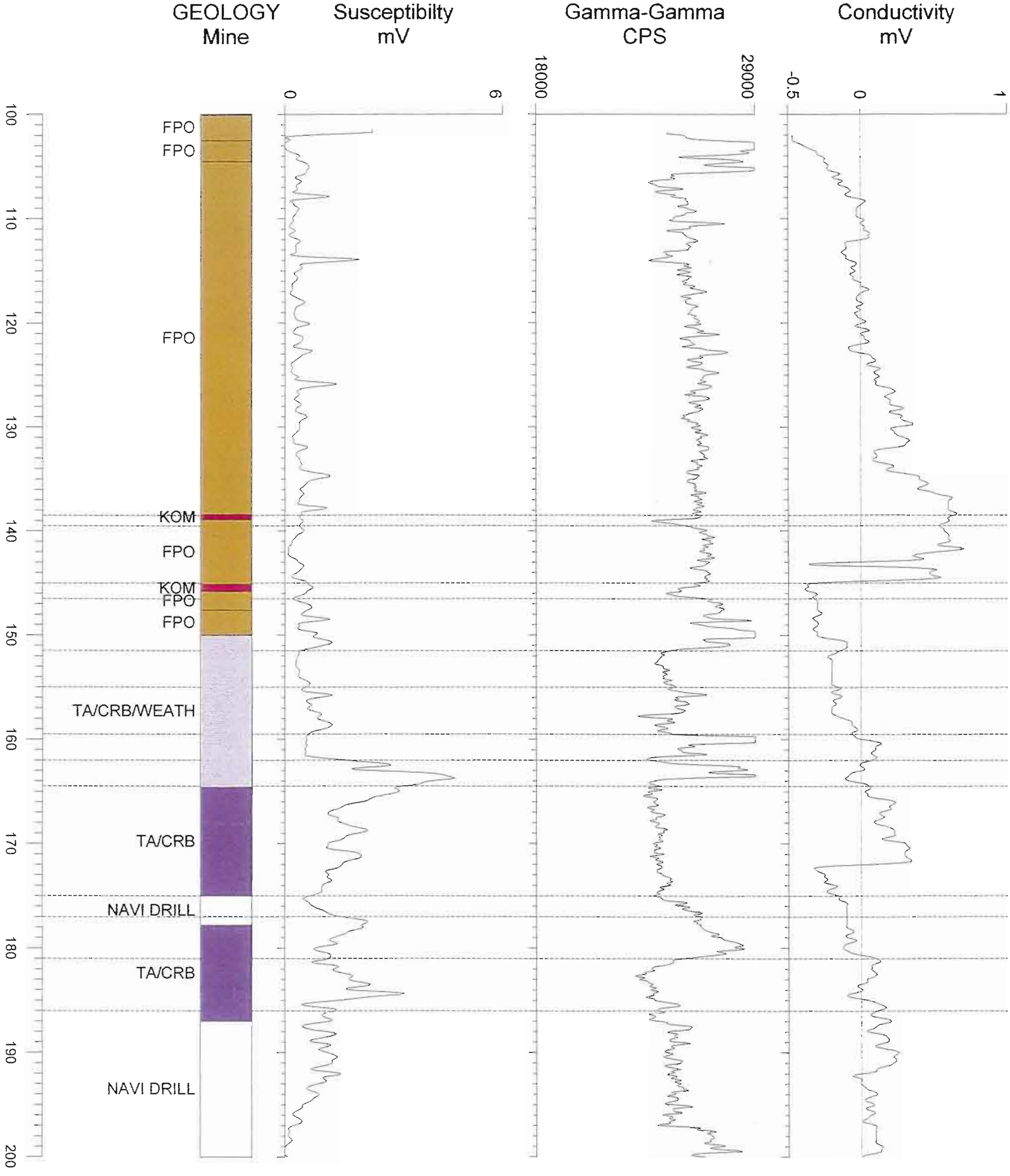


Figure 4.16b

BSD 44A

Interpreted Geophysical Subdivisions (200-370m)

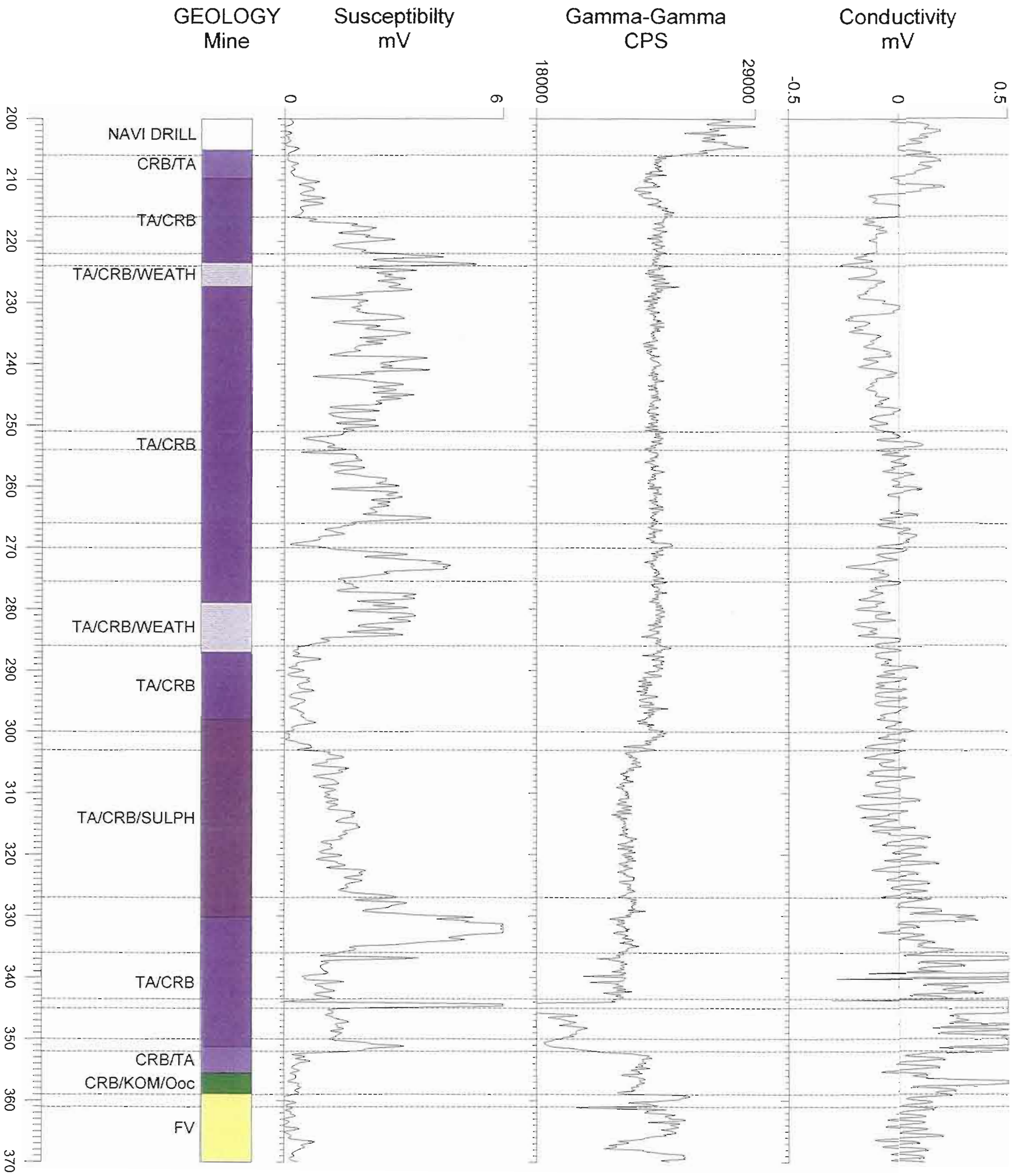


Figure 4.17a

BSD 44A

Interpreted Geophysical Subdivisions (100-200m)

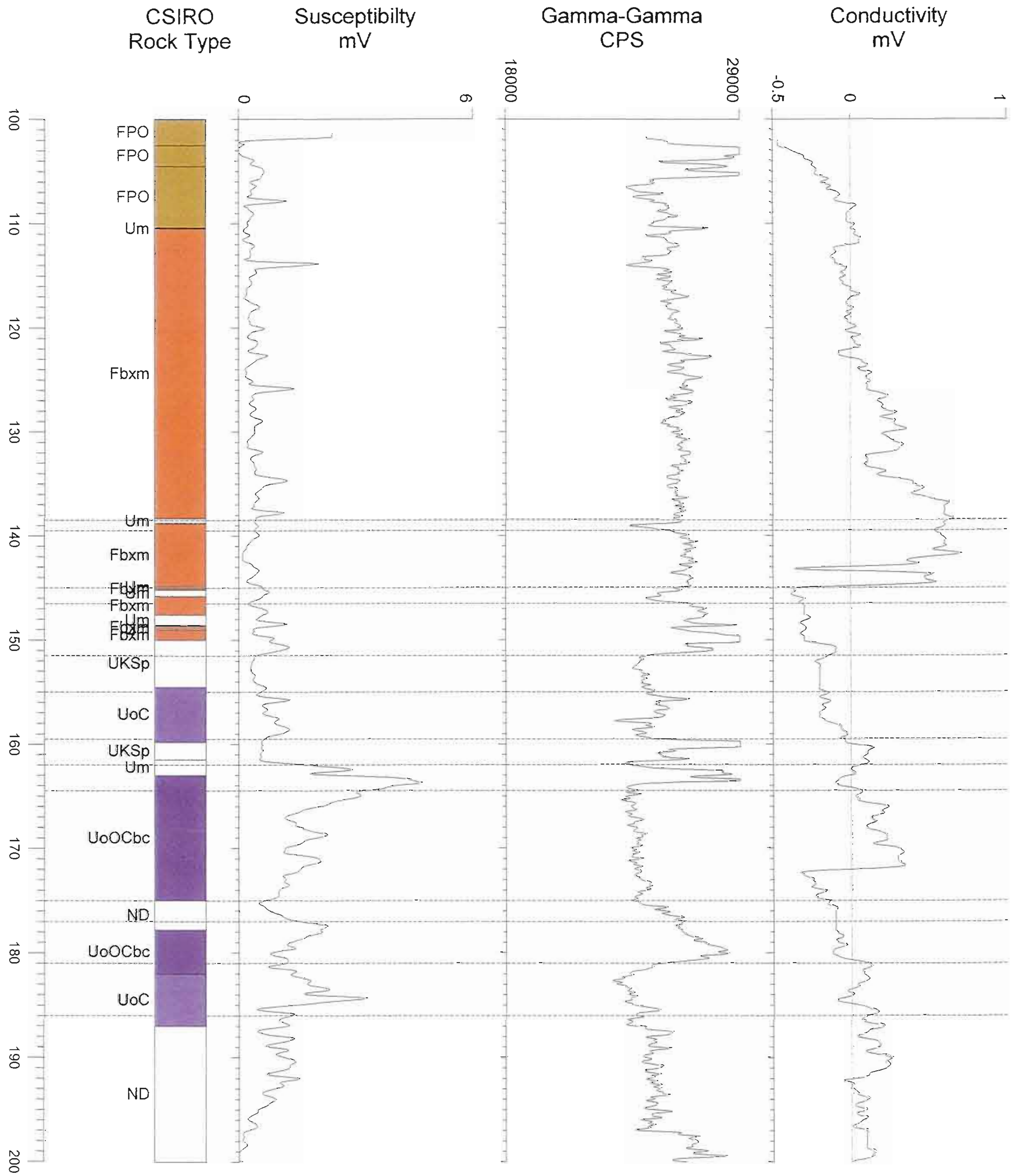
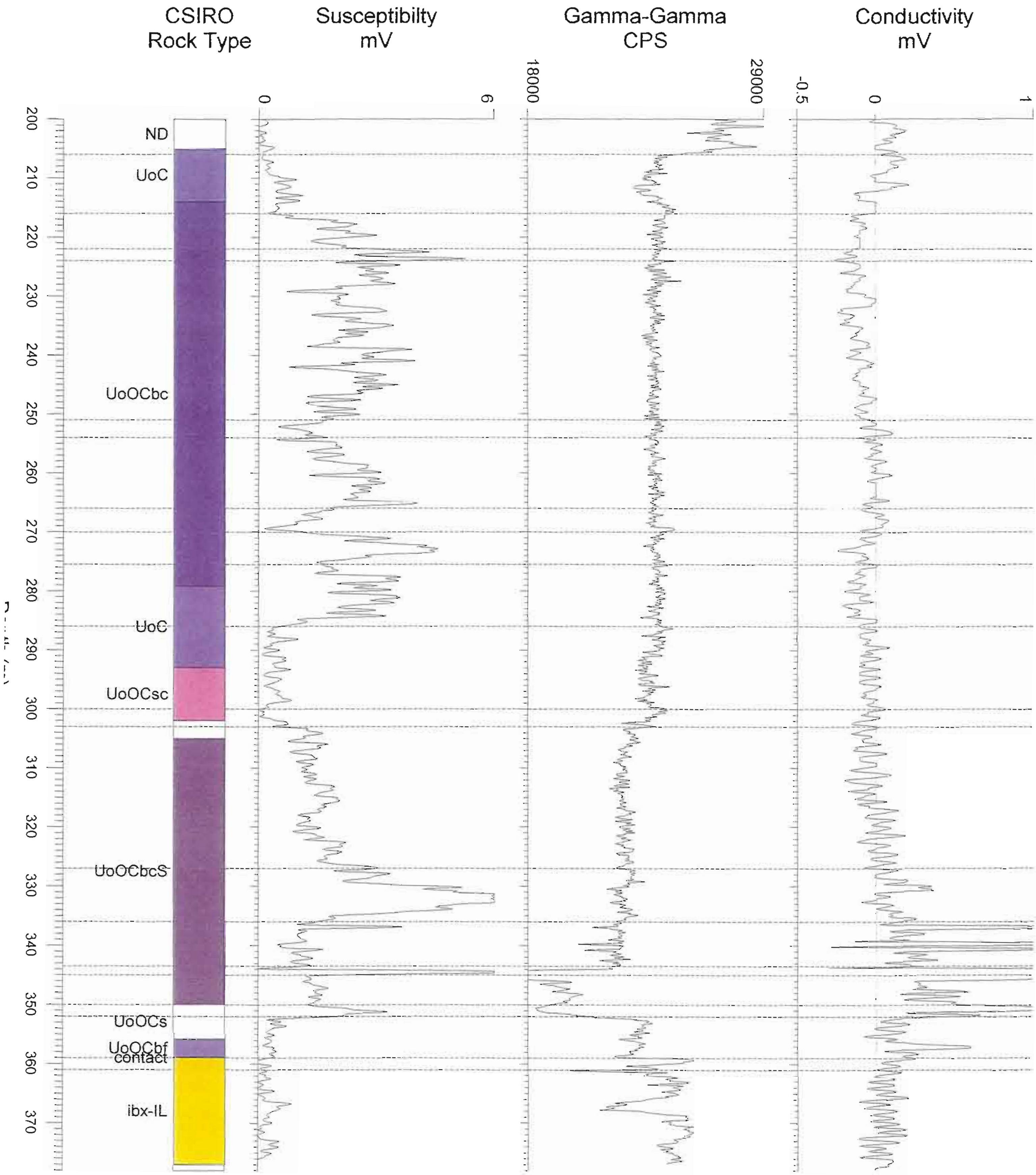


Figure 4.17b

BSD 44A

Interpreted Geophysical Subdivisions (200-370m)



BSD 44A 138m-138.5m

There is direct correlation between the geological logs and the gamma-gamma and conductivity logs in this interval. A thin finger of ultramafic was logged and appears to correspond to a low in the gamma-gamma logs, and a slight drop in the conductivity logs. The rock above this interval is felsic volcanic and is moderate to highly conductive.

BSD 44A 138.5m-145m

A general decrease in magnetic susceptibility and increase in ~~to~~ gamma-gamma values is noted prior to the 138m-depth marker, and characterises this interval. The conductivity is erratic but remains moderate to high. A slight spike in the magnetic susceptibility appears to correspond to a dip in the gamma-gamma log, and a major dip in the conductivity log. This may represent another thin finger of ultramafic rock that is not noted in the geological logging.

BSD 44A 145m-146.5m

There is a direct correlation between the geological logs, and the conductivity and gamma-gamma logs in this interval. A small increase in the magnetic susceptibility occurs but the sharp drop in the conductivity and gamma-gamma logs characterises this interval, which corresponds to a logged, thin finger of ultramafic. Chlorite-filled vesicles are evident in thin section and the mineralogy consists of a chlorite-talc-carbonate-quartz assemblage.

BSD 44A 146.5m-151.5m

An overall increase in gamma-gamma and a decrease in magnetic susceptibility characterises this interval. It was interpreted as a felsic volcanic unit, which corresponds to the geological logs. The conductivity over this interval does not rebound back to the values shown by the felsic volcanics above this interval. This may be a function of varying degrees of alteration during and post emplacement, as this unit is in direct contact with an ultramafic unit.

BSD 44A 151.5m-155m

A subtle decrease in magnetic susceptibility and a dramatic decrease in the gamma-gamma correlate with the geological logs where a pyroxene spinifex zone has been logged. A subtle decrease in conductivity also occurs. The exact geophysical contact differs slightly however to the mapped geological contact. A2 pyroxene spinifex was logged as confirmed in thin section. The mineralogical assemblage consists of chlorite-carbonate-quartz. No opaque mineralogy was observed.

BSD 44A 155m-159.5m

An increase in magnetic susceptibility and gamma-gamma marks the onset of this interval, and corresponds to CSIRO's geological logging of an orthocumulate unit. There is no real change in the conductivity, although it does become slightly more erratic. The rock type consists of olivine orthocumulate. A thin section was taken of a sample that is characterised by a spike in both the magnetics and gamma-gamma logs. Up to 1% magnetite was observed.

BSD 44A 159.5m-162m

A direct correlation between the physical properties and the CSIRO geological logging was noted, and is marked by a subtle decrease in the magnetic susceptibility, a marked increase in the gamma-gamma log, and a slight increase in the conductivity. This interval consists of random A2 pyroxene spinifex.

BSD 44A 162m-164.5m

A sharp increase in magnetic susceptibility and a spike in the gamma-gamma log correlate with the CSIRO geological logging over this interval. Conductivity decreased slightly. A weathered carbonate-quartz-chlorite rock with up to 2% magnetite and trace haematite is observed in this section and interpreted to represent an olivine orthocumulate.

BSD 44A 164.5m-175m

A dramatic decrease and subdued consistent response in the gamma-gamma logs corresponds to a change in the CSIRO geological logs. The average magnetic susceptibility values are higher but exhibit a number of spikes at 167m, 169m and 171.5m depths. In a thin section sample taken at 167m depth, 8% magnetite was observed in a dominantly talc-carbonate-quartz rock. At 170m depth, 4% magnetite was observed in a talc-carbonate-chlorite-quartz rock. At 173m, a sudden drop in the conductivity occurs which correlates to a small spike in the gamma-gamma log. The present mineralogy represents a primary olivine orthocumulate rock. 5% magnetite was observed in thin section at a depth of 174m, in a bimodal olivine orthocumulate represented by a present mineralogy of talc-carbonate-quartz.

BSD 44A 175m-177m

An initial increase in the gamma-gamma conductivity and magnetic susceptibility logs occur at 175m depth. This corresponds to the onset of the navi-drill (change in direction of drilling) interval which is not calliper corrected.

BSD 44A 177m-181m

A decrease in the magnetic susceptibility and an increase in the gamma-gamma log occur over this interval, which correlates to the CSIRO geological logging indicating bimodal olivine orthocumulates. The conductivity change is an extremely subtle decrease.

BSD 44A 181m-186m

A correlation with the CSIRO geological logs also occurs over this interval. The petrophysics are characterised by an increase in magnetic susceptibility and a decrease in the gamma-gamma logs. A slight increase in conductivity occurs. At 184m depth, a small negative spike in the magnetic susceptibility and conductivity occurs, corresponding to a small positive spike in the gamma-gamma logs.

BSD 44A 186m-206m

A sharp increase in the gamma-gamma logs heralds the onset of the navi drill. The intensity of the magnetic susceptibility and conductivity do not change markedly. At 196m depth, a decrease in the magnetic susceptibility is accompanied by a significant increase in the gamma-gamma log. No core was available for logging but a change in lithology is inferred.

BSD 44A 206m-216m

A correlation with the CSIRO geological logs occurs at this interval and is represented by a decrease in magnetic susceptibility and an increase in the gamma-gamma log. No marked change in conductivity is evident. A dominantly carbonate-talc assemblage is observed over this interval.

BSD 44A 216m-287m

This is a large interval over which the gamma-gamma and conductivity logs are quite subdued. However, the magnetic susceptibility is erratic, generally moderate to high, and hence sub-intervals can be defined as observed on figure 4.16b. Thin sections were taken from samples over these sub-intervals. Thin sections at depths of 223m and 227m, show dominantly talc-carbonate-quartz rocks exhibiting bimodal textures and between 4% and 6% magnetite, mainly in particle form, respectively. This may account for the spikes and the increase in magnetic susceptibility. The rocks between 227m and 251m are dominantly carbonate quartz rocks with varying degrees of talc and chlorite, exhibiting bimodal textures. The thin sections taken also contain approximately 3% magnetite, with 1% chromite being observed at 250m depth. The rocks with the dominantly talc-carbonate assemblage appear to exhibit slightly lower magnetic susceptibilities whilst still containing similar amounts of magnetite.

A spike in the magnetic susceptibility at 266m may be due to the 5% magnetite observed in thin section in a dominantly talc carbonate rock exhibiting bimodal textures. Over the interval 270m to 275m, a talc carbonate rock containing 3-4% magnetite exists, but no obvious bimodal textures were observed. At 284m depth, 2% haematite and trace magnetite is noted in olivine orthocumulate rocks, which correlates with the geological logs.

BSD 44A 287m-300m

A sharp decrease in magnetic susceptibility indicates a geophysical subdivision at this depth but this does not correlate with the geological logs. The sharp decrease in magnetic susceptibility corresponds to an extremely small increase in the gamma-gamma and conductivity logs.

BSD 44A 300m-302m

Lower magnetic susceptibilities and higher values from the gamma-gamma log persist over this small interval. No change in the conductivity log occurs.

BSD 44A 302m-327m

A decrease in the gamma-gamma logs and a slight increase in the magnetic susceptibilities marks a geophysical interval change. This contact correlates with the CSIRO and mine geological logs, and with the presence of disseminated nickel sulphides and chromite.

BSD 44A 327m-337m

This interval is denoted by an increase in magnetic susceptibility. A small spike in the conductivity also occurs.

BSD 44A 337m-343.5m

A decrease in magnetic susceptibility occurs over this interval but is similar to physical and mineralogical characteristics of geophysical interval 303-327m. There is a significant increase in conductivity and this interval is characterised by large spikes in the conductivity, which possibly corresponds to an increase in sulphides at those points.

BSD 44A 343.5m-345m

A sharp inverse relationship between the magnetic susceptibility and conductivity, and the gamma-gamma log occurs over this interval, and may reflect the increase in sulphides noted in the thin sections. However, mineralogically, the interval is similar to the last interval discussed. The geochemical analysis shows the percent nickel to increase from approximately 2% to 5% over this interval.

BSD 44A 345m-350m

The magnetic susceptibility remains constant and has similar amplitude to below 343m depth. However, the gamma-gamma log shows lower amplitudes. The conductivity is elevated over this interval but exhibits no major spikes. The rock type is an olivine sulphide orthocumulate represented now by a dominantly carbonate-talc assemblage. An increase in sulphide content is noted.

BSD 44A 350m-352m

This is interval is characterised by an increase in magnetic susceptibility, a decrease in the gamma-gamma logs, and a large increase in conductivity. The upper boundary of this interval correlates to the geological boundary, supposedly marking the end of mine geologist logged nickel sulphides, however a large positive spike in the c onductivity would suggests the opposite. Cross-referencing with the assays indicates that there are nickel sulphides present with the geochemical boundary at 353.12m depth.

BSD 44A 352m-356m

The lower boundary of this interval corresponds to the lower boundary of the sago-textured olivine orthocumulate rocks as logged by the CSIRO. A decrease in the magnetic susceptibility, a sharp decrease in the conductivity, and an increase in the gamma-gamma log occur.

BSD 44A 356m-359m

A slight dip in the gamma-gamma log and a positive spike in conductivity, correlate with a change in both the mine geologist and CSIRO geological logs, from sago-textured to bimodal textured olivine orthocumulate.

BSD 44A 359m

This boundary correlates with the geological boundary between the ultramafic and felsic footwall rocks as logged by the mine geologist and CSIRO. A sharp large increase in gamma-gamma, and a moderate decrease in the magnetic susceptibility and conductivity denote this contact.

4.4.2 Statistical Approach/ Cross Correlation

This visual subdivision of the geophysical logs is not objective. A statistical/cross correlation approach was also used.

Cross plots of multiple variables were produced based on diamond hole BSD 44A. CSIRO logged rock types were simplified by the author and were used and compared against downhole measurements of magnetic susceptibility, gamma-gamma and conductivity. The relationship between the simplified and original CSIRO logs is explained in Table 4.1. Simplified CSIRO logged rock types were used, as these logs appear from the above discussions to be more accurate at delineating geological boundaries than those logged by the mine geologist. The following observations were made:

4.4.2.1 Conductivity and Magnetic Susceptibility (Figure 4.13)

The disseminated sulphides exhibit the greatest range and scatter in relation to conductivity. This variation in range is expected, and would relate to the amount of conductive sulphides within the rock. A difference in magnetic susceptibility between the felsic and ultramafic rocks was anticipated but not seen.

4.4.2.2 Conductivity and Gamma-Gamma (Figure 4.14)

A useful plot in discriminating between ultramafic and felsic rocks. The felsic rocks display higher gamma-gamma values hence are interpreted to be less dense then the ultramafic counter parts. The ultramafic olivine cumulates hosting disseminated sulphides have lower gamma-gamma values, i.e. more dense, and have varying magnetic susceptibilities.

4.4.2.3 Magnetic Susceptibility and Gamma-Gamma (Figure 4.15a)

The magnetic susceptibility and Gamma-Gamma plot exhibits the greatest number of populations (populations A-F) as discussed in *section 4.23.4* of this report. These populations are interpreted to be invariably related to rock type. Population A displays lower gamma-gamma values.

Populations A, B and C relate to olivine cumulate rocks hosting disseminated mineralisation. All of the populations have lower gamma-gamma values then other rock types hence are denser. One group exhibits lower magnetic susceptibilities and is divided into two populations with differing densities (A & B). The third population shows the highest magnetic susceptibilities (C) but have similar inferred densities to population B.

Population B has higher gamma-gamma values and can be differentiated from population C by a difference in magnetic susceptibility. Populations E and F display lower magnetic susceptibilities than population C but appear to have differing gamma-gamma median.

Population D displays a wide range of magnetic susceptibilities and a relatively discrete range of gamma-gamma values. This population correlates with the logged bimodal textured olivine orthocumulates (UoOCbc), which may at a closer inspection be separated into two sub-populations. The first sub-population could possibly be separated into two groups, with one group having still higher magnetic susceptibilities. The second more obvious sub-population shows a slight linear relationship between magnetic susceptibility and gamma-gamma. As the rocks become less dense the magnetic susceptibility increases. A number of logged oOC are scattered through the first sub-population and may actually be a bimodal olivine orthocumulate, but have been mislogged.

Again on closer inspection, making use of the rock type indicators, (see Figure 4.15b), population E can be separated into two sub-populations. The first being a discrete group having lower magnetic susceptibilities and being less dense. This sub-group correlates with the logged fine-grained bimodal olivine orthocumulates. The second sub-population exhibits a wider range of magnetic susceptibilities and density values and correlates with the spinifex-textured Komatiite.

Population F corresponds to logged felsic volcanic rocks. The population shows similar susceptibilities the spinifex-textured Komatiites but is less dense.

4.4.2.4 Magnetic Susceptibility and CSIRO Logged Rock Type (Figure 4.18)

On analysis of the cross plot between magnetic susceptibility and CSIRO logged rock type the following observation can be made.

- The coarser grained bimodal olivine orthocumulates containing disseminated sulphides (*UoOCbc$)* exhibit the largest range and highest magnetic susceptibilities with the oOC and oOCbc having similar magnetic susceptibility ranges.
- The coarser grained bimodal olivine othocumulates (oOCbc) have a greater magnetic susceptibility range then their finer grained counterparts (oOObf).
- The felsic volcanics have similar magnetic susceptibility ranges to the ultramafics, which was not anticipated.

Figure 4.18
BSD 44A Downhole Magnetic Susceptibility & Simplified CSIRO Logged Rock Type

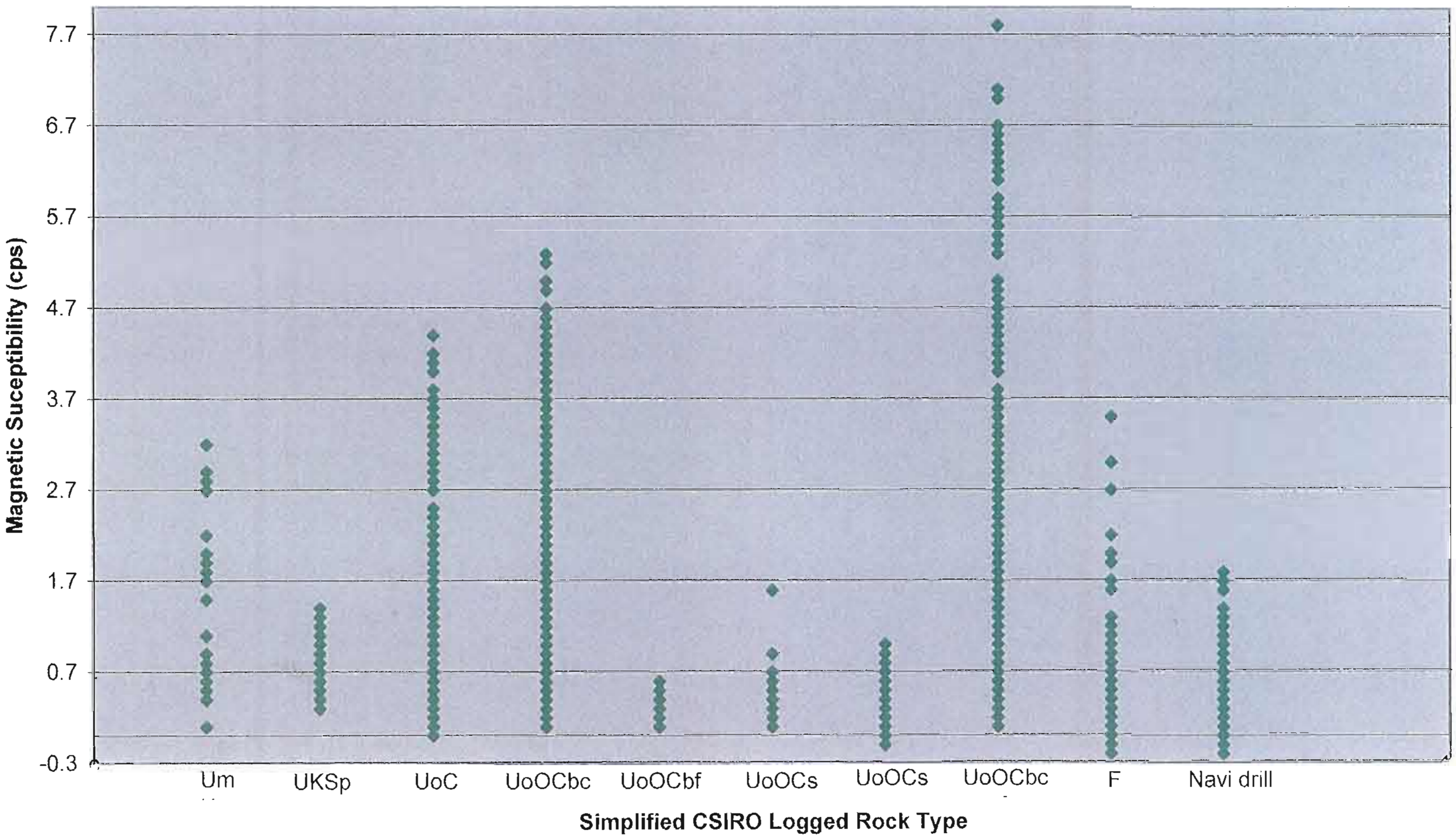


Table 4.4 represents the average magnetic susceptibility in cps for the relevant rock types.

Table 4.4 Magnetic Susceptibility (cps) of Black Swan Succession Rock Types

Rock Type	Um	Uksp	UoC	UoOcbc	UoOcbf	UoOCs	UoOCsc	UoOCbc$	F
Mean	1.082	0.569	1.079	2.109	0.322	0.413	0.392	1.95	0.390
Standard Deviation	0.823	0.274	0.953	0.979	0.116	0.285	0.212	1.400	0.323

4.4.2.5 Gamma-Gamma and CSIRO Logged Rock Type (Figure 4.19)

A cross plot between gamma-gamma and CSIRO logged rock type exhibits expected trends. The rocks containing sulphides show the lowest range of gamma-gamma, and therefore have the highest densities. Spinifex-textured rocks exhibit the highest gamma-gamma range, and therefore are the least dense rocks. UoOCbc show the greatest range of densities amongst the orthocumulates.

Table 4.5 represents the average gamma-gamma in cps for the relevant rock types.

Table 4.5 Gamma-Gamma (cps) of Black Swan Succession Rock Types

Rock Type	Um	Uksp	UoC	UoOcbc	UoOcbf	UoOC	UoOCs	UoOCbc$	F
Mean	25985	26541	24143	24190	22892	23179	23653	21879	25615
Standard Deviation	1477	3293	839	870	457	483	461	1424	1323

4.4.2.6 Conductivity and CSIRO Logged Rock type (Figure 4.20)

The observations made from the Conductivity and CSRIO logged rock type is that UoOCbc$ - has a large range and is the most conductive rock type, due to the presence of conductive sulphide. A direct correlation between conductivity and the presence of sulphide in the rock can be made.

Felsic volcanics exhibit a wide range of conductivity whilst sago-textured olivine orthocumulate shows the smallest range. Spinifex rocks are the least conductive rocks.

Figure 4.19
BSD 44A Downhole Gamma-Gamma & CSIRO Logged Rock Type

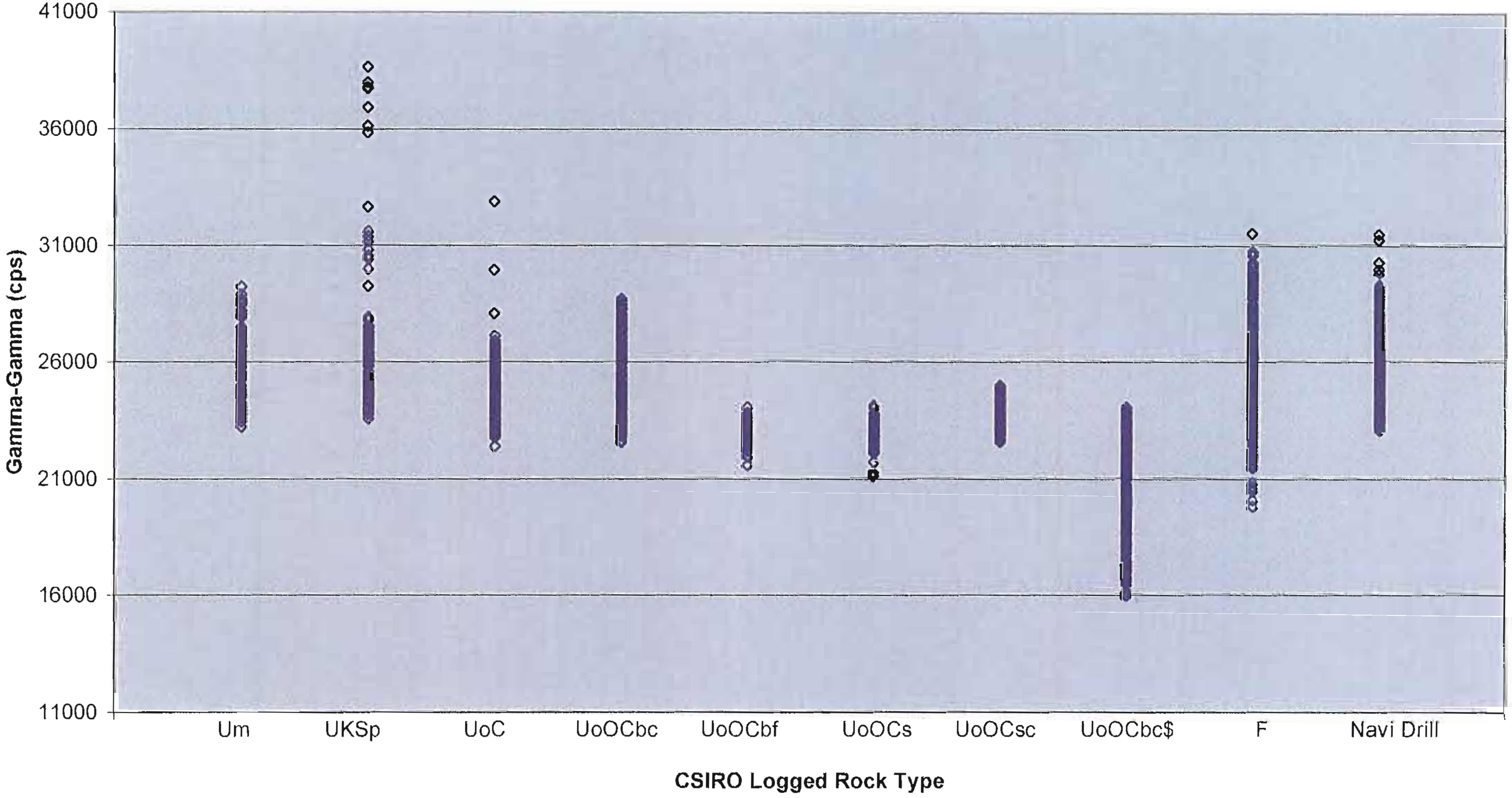
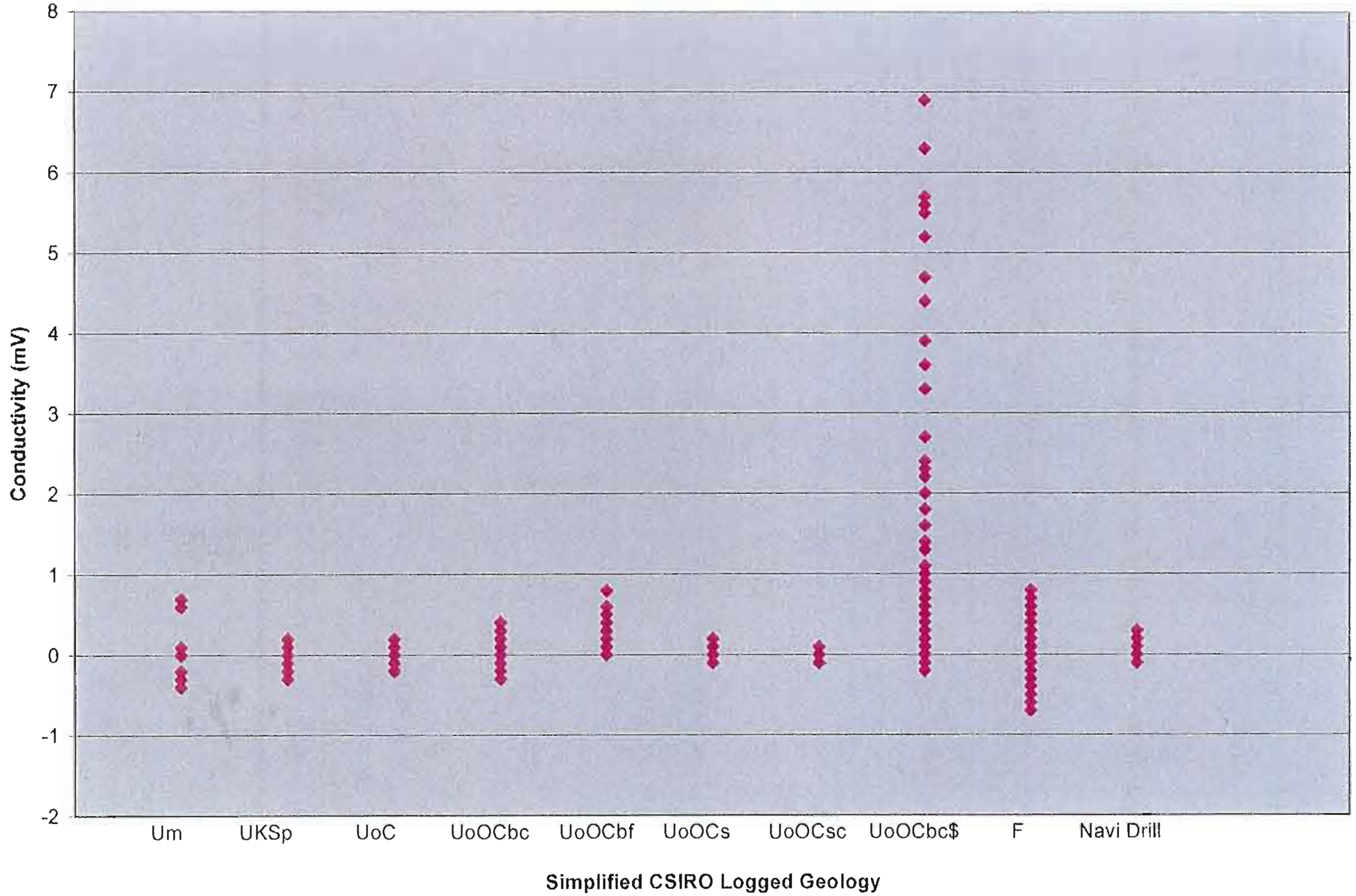


Figure 4.20
BSD 44A Downhole Conductivity and Simplified CSIRO Logged Geology



4.4.3 Discussion on Statistics

In theory, geophysics should be a more reliable tool in logging core since it provides a repeatable objective method of lithological discrimination. However, this study shows that the detailed logging at hand specimen and microscopic scales is generally more reliable in this environment. Given that is during exploration is most cases such specialised logging is not permitted the geologist may use the geophysics as a tool to indicate subtle changes in geological units.

In summary, the felsic rocks are less dense with variable magnetic susceptibility. The mean magnetic susceptibility values of the felsic rocks were similar to some of the olivine cumulate rocks, which is not what one would generally expect. This could probably be attributed to the pervasive alteration evident in the Black Swan area.

The olivine cumulate rock hosting the disseminated sulphides is the most dense rock type. The opaques, in particular the sulphides, are the most probable reason for this phenomenon.

The coarse-grained bimodal olivine orthocumulate has the highest mean magnetic susceptibility, which is not necessarily expected, as the ore-hosting rocks would generally be considered more susceptible.

CHAPTER FIVE

Petrology

5.0 PETROLOGY

Diamond core samples from the geophysically mapped intervals were taken and thin sections made. The petrography of the rocks was studied in conjunction with both the measuring of physical properties and field mapping for two main reasons. Firstly, to find characteristic mineral assemblages for each main rock type, so a direct comparison could be made between rocks of similar composition but different metamorphic grade. Secondly, the mineral assemblages need to be known to quantify any changes in density or magnetic properties of different rock types.

The diamond holes BSD 44A, BSD 59 and BSD 86 were chosen for this study to represent both channel and flanking environments within a Komatiite lava pathway. Cross section of holes BSD 44A and BSD 59 are illustrated as Figures 5.1 and are located on Figure 5.2. Downhole petrophysical measurements of these holes were to be made available. The holes were also geologically logged and their volcanological textures interpreted.

The petrophysically mapped intervals (discussed and illustrated in section 4), together with geological core logs, were used as a base to select samples for detailed petrographic study. Samples were cut from the diamond core and thin sections made. The petrography of the rocks was studied in conjunction with the measuring of physical properties and field mapping for two main reasons:

- Firstly, to find characteristic mineral assemblages for each main rock type, so a direct comparison could be made between rocks of similar composition but different metamorphic grade.
- Secondly, knowledge of the mineral assemblages was required in order to quantify any changes in density or magnetic properties of different rock types.

The opaque minerals, in particular, are discussed in detail because of their control on the rock magnetic properties.

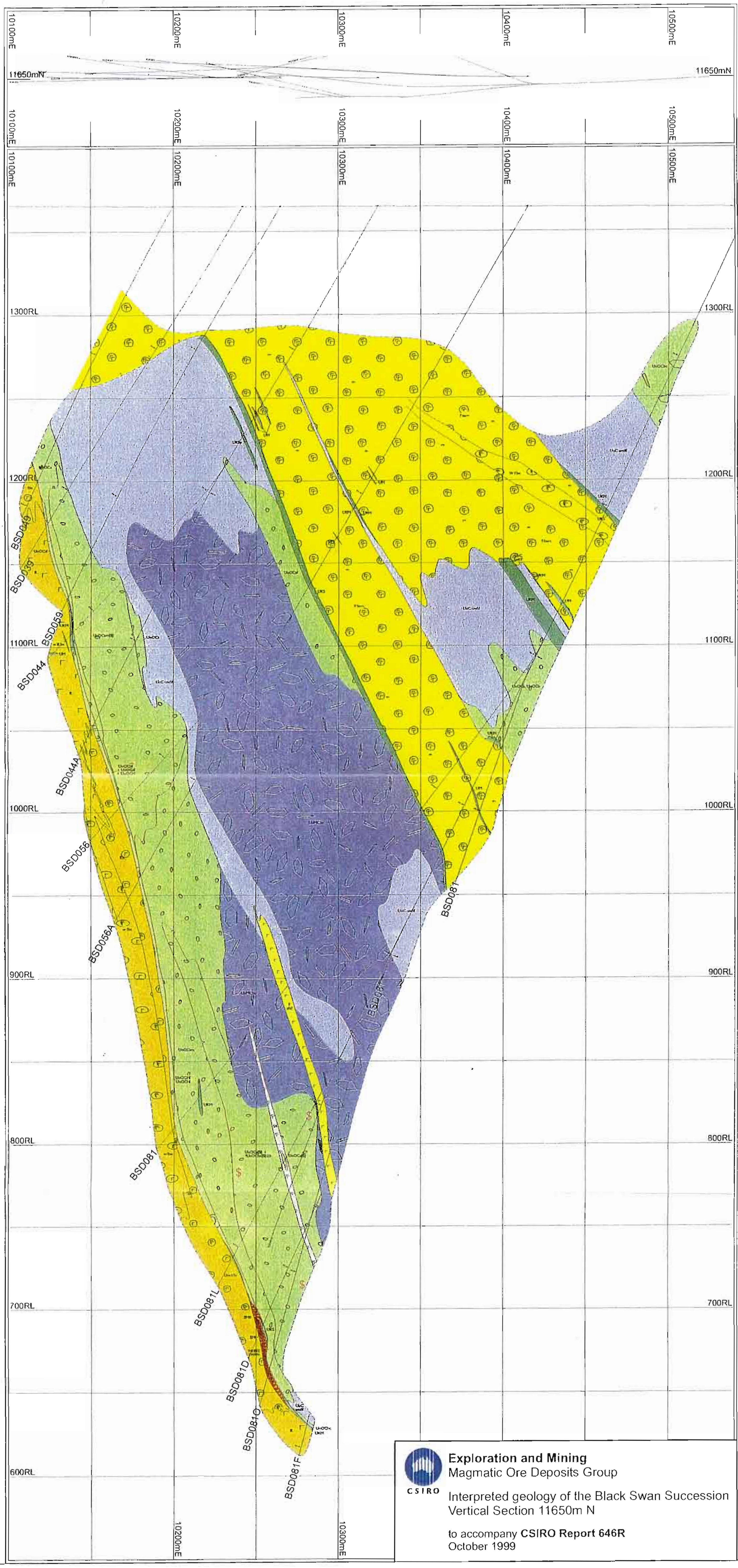
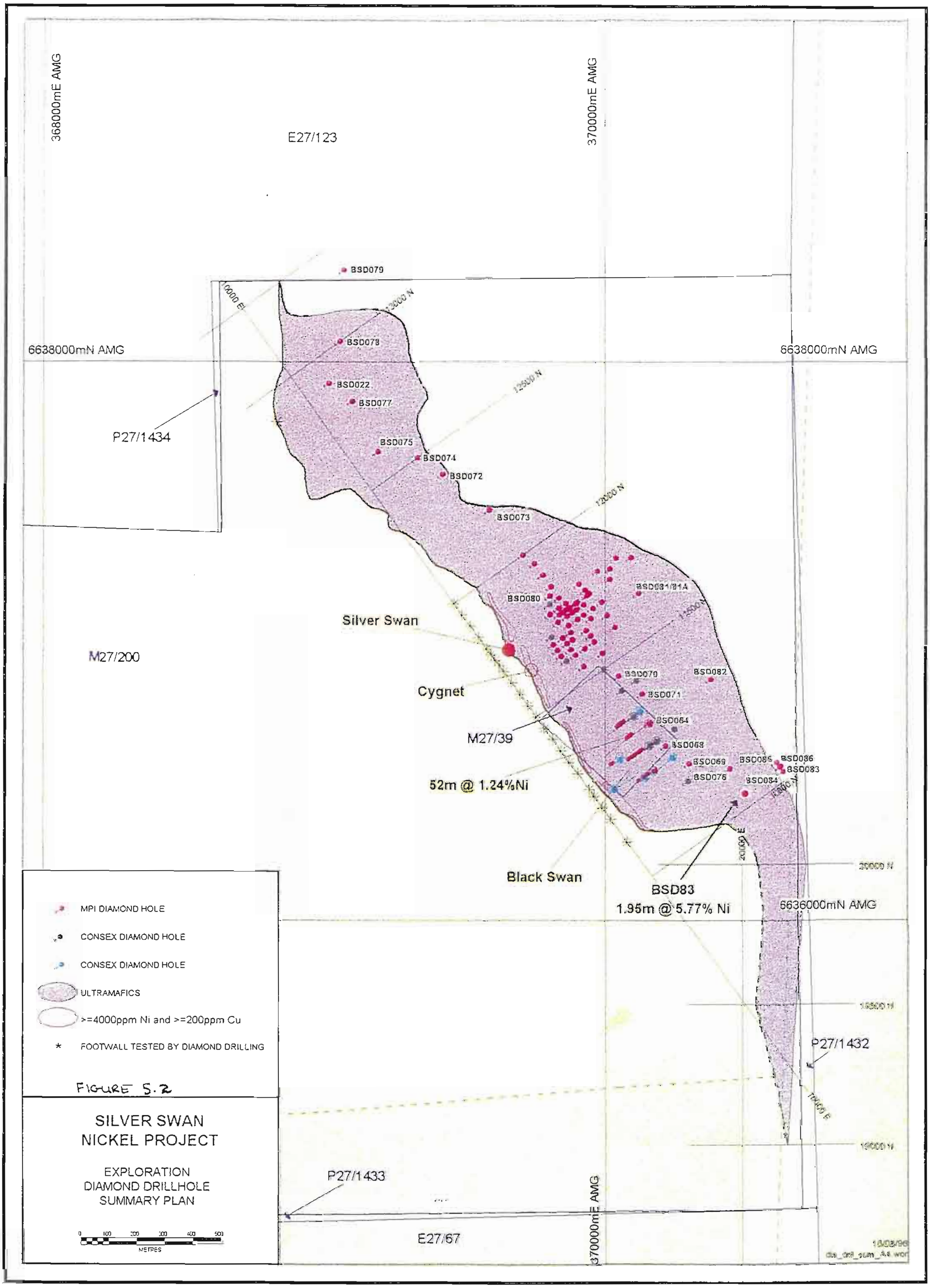

11650mN
1300RL
1200RL
1100RL
1000RL
900RL
800RL
700RL
600RL
10100mE
10200mE
10300mE
10400mE
10500mE
BSD044
BSD044A
BSD056
BSD056A
BSD059
BSD081
BSD081L
BSD081D
BSD081O
BSD081F
Exploration and Mining
Magmatic Ore Deposits Group
CSIRO
Interpreted geology of the Black Swan Succession
Vertical Section 11650m N
to accompany CSIRO Report 646R
October 1999

Figure 5.1


368000mE AMG
370000mE AMG
E27/123
BSD079
BSD078
BSD022
BSD077
BSD075
BSD074
BSD072
BSD073
BSD080
BSD081/81A
6638000mN AMG
6638000mN AMG
P27/1434
Silver Swan
M27/200
Cygnet
M27/39
BSD070
BSD071
BSD082
BSD064
BSD063
BSD069
BSD076
BSD085
BSD086
BSD083
BSD084
52m @ 1.24%Ni
Black Swan
BSD83
1.95m @ 5.77% Ni
6636000mN AMG
P27/1432
P27/1433
E27/67
MPI DIAMOND HOLE
CONSEX DIAMOND HOLE
CONSEX DIAMOND HOLE
ULTRAMAFICS
>=4000ppm Ni and >=200ppm Cu
FOOTWALL TESTED BY DIAMOND DRILLING
FIGURE 5.2
SILVER SWAN
NICKEL PROJECT
EXPLORATION
DIAMOND DRILLHOLE
SUMMARY PLAN
METRES

The results of this study are noted in Table.5.1.

The mineralogies observed were discussed in section 2 of this report. A detailed description of the textures observed is provided below.

5.1 Textures observed in this study

5.1.1 Spinifex Textures

Spinifex textures are preserved in BSD 86 (refer to Figures 2.8a & 2.8b), which lies within the Southern Flanking Zone of the BSS. A chlorite-quartz carbonate assemblage is observed with the original olivine blades normally pseudomorphed by finely intergrown quartz and chlorite. Vesicular and spinifex textures denoting the flow top (Figure 5.3a & 5.3b) are also present and are infilled by phases including chlorite, quartz, carbonate.

5.1.2 Cumulate Textures

Olivine orthocumulate and olivine mesocumulate rocks with olivine crystals displaying different shapes were noted. Textural differences also appeared to occur within the groundmass. Hill *et al.* (1999) reports these variations as providing information regarding the rock's cooling history.

Olivine textures identified by CSIRO, and by the author, within the above mentioned holes include sago, wormy, hopper, bimodal and platy although the textures are difficult to discern even in thin section.

Sago, wormy and hopper-textured cumulates are interpreted to have formed from a single stage cooling process in hot insulated environments. Bimodal textures containing both polyhedral and platy olivines reflect at least two stages of cooling (Hill *et al.*, 1999).

Table 5.1 : THIN SECTION DESCRIPTIONS																																		
Drill hole No.	Depth (m)	Olivine Mineralogy (decreasing abundance 1->10)										Opaques %			Total % opaques	Spinifex Texture		Others	Vesicles present	Protolith	Sulphides	Crystal size			Packing Density		Crystal shape				Texture			comments
		Lizardite	antigorite	carbonate	talc	pyroxene	chlorite	tremolite	quartz	feldspar	sericite	chromite	magnetite	hematite		A2	A3				modal%	fine <0.25cm	medium 0.25-0.75	coarse >0.75cm	loose	tight	euhedral	subhedral	anhedral	bimodal	poikilitic	porphyroblastic	serpentinisation	
BSD 44A	135								1	2			1		1					felsic		x		x			x					x		
	138.6			1	3(laths)		2		4				1		1					oOCb		x	x				x			x		'	x	
	145.6			3	2		1		4				1		1				x	oOCv			x									x		
	150								1	2			2	1	3					felsic		x						x						weathered/brown
	153.1			1	3		4		2			1			0	random(mainly				UkSo/p		x												is it spinifex??
	156.4			1	3		2		4				1		1					oOC		x											x	
	162			1			3		2				2	trace	2					is it spinifex or														weathered/brown
	167			2	1		trace		3				6		6					oOC		x						x				carbonate	x	
	170			2	1		3		4				4-Jan		4	x?				hybrid/UK So														
	174			1	2(insome places3)				3(in some places 2)				5 and dusty		5					oOCb		x								x		carbonate	x	
	183			1	2		4		3			chlorite replace	4 & dusty	trace	4					oOCb		x						x		x?				some suggestion of blading, carb vein with minor chl, tc, qtz, sharp
	186			2	1		trace		3				5		5					oOCb		x												carbonate veining
	207			1	2		4		3			trace	0		trace					oOCb-om		x								x	talc			
	213			1	2		4		3				5		5							x								x		carbonate	x	
	218			1	3		4		2				2&dusty	trace	2					oMC		x								x			x	
	223			2	1				3				6 & dusty		6					oOCb		x?					x, blading suggested			?			x	
	227			2	1		4		3			trace	4		4					oOCb										x		carbonate	x	
	233			1	2		4		3				2	2	4																			
	237			1	3		4		2				2 & 1 dusty	1	4					oOCb							x			x			x	quartz vein-hint of possible blades
	242			1	2		4		3				3 & 1		4					oMC-oOCb										x			x	
	245			1	4		3		2				2		2					oOCb										x			x	
	250			1	4		3		2			1	2-Jan		3					oOCb								x		x			x	radiating txt
	254			1	2		4		3				3		3					oOC		x								x			x	very milky carbonate
	256			1	4		3		2				2		2					oOCb										x			x	
	262			1	2		trace		3				1	1	2					oOCb		x				x	x			x		carbonate	x	carbonate veining
	266			2	1		trace					trace	5 & dusty		5					oOCb										x			x	fibrous
	268			1	2		3		4				5		5					oOC							x					carbonate	x	interesting txt-or do olivines make up elongate grains
	272			2	1		trace						3		3					oOC										x		carbonate	x	
	275			1			2						4		4												x			x			x	
	280			1	2		3 trace		4				1 &1		2					oOC								x					x	
	284			2	1		3		4				<1	2	2														x	hint			x	good txt (check if chromite)
	292			2	1		3					>1 lobate lge	1		1					oOC			x									carbonate	x	
	301			1	3		4					trace	1 dusty	1						oOC		x											x	
	306			1	2 (fibrous & fgr)							1	2 dusty	trace	3					oOC									x	x		carbonate	x	
	311			1	2 (fibrous & fgr)							1 skeletal	1 dusty	trace	5					osOC	3		x					x		x			x	
	314			1	2		3					<1 polk, lob	1		3					osOC	2		x				x			x			minor	
	320			2	1		3					trace polk, lob	2 & dusty		10					osOC	8						x			x		carbonate	x	
	324			2	1		3						1 & dusty		4					osOC	3-Jan						x			x		carbonate		
	327			2	1		3					1 lobate, polk	1		5					osOC	3							x		x			x	
	333			1	2		trace						dusty		5					osOC	5									x		carbonate	x	
	337			1	2		3						dusty		7					osOC	7						x			x		carbonate	x	
	340			1	2		3						dusty		4					osOC	5									x		carbonate		
	342			1	2		3-minor		4				dusty		5					osOCb	5							x		x			x	
	345			2	1		4		3				<1	2	2					osOC	10		x						x	x		carbonate	x	
	348			1	2		4		3				1	trace	5					osOC	4		x							x		carbonate	x	
	352			2	1				3			trace	2		2																		x	

Drill hole No.	Depth (m)	Olivine Mineralogy (decreasing abundance 1->10)										Opaques %			Total % opaques	Spinifex Texture		Others	Vesicles present	Protolith	Sulphides	Crystal size			Packing Density		Crystal shape				Texture			comments
		Lizardite	antigorite	carbonate	talc	pyroxene	chlorite	tremolite	quartz	feldspar	sericite	chromite	magnetite	hematite		A2	A3				modal%	fine <0.25cm	medium 0.25-0.75	coarse >0.75cm	loose	tight	euhedral	subhedral	anhedral	bimodal	poikolitic	porphroblastic	serpentinisation	
	354			2	1				3 large amounts			1 subhedral?	1		2					oOCs												finer than 343		
	357			2	4		1		3																									carbonate mosiacs aligned
BSD 59	235			1	2 (laths and felted)		3		4				1		4					osOCb	2		x					x		x	qtz	carbonate	x	
	228			2	1		4		3 (large amounts)				dusty		4						4		x							possible		carbonate	x	
	231			1	2		3						2	dusty	4					osO-MC	2					x		x				carbonate	x	
	238			1	2				3			trace lobate	2	dusty	5					osoCb?	3	x						x		x?		carbonate	x	
	240			1	2		minor		3				8		10					oSMC	2		x							x		carbonate	x	lots of magnetite, sheared stretched fabric
	258			1	2		minor		3			?lobate	2-sheared		4					oOCb M cause not	2	x						x		x	carbonate	carbonate		
	261			1 (some vfgr	2				3			1	1		2					oO-MC			x							x	qtz-carb		x	
	267			fg	4(minor)		3 minor		2			lobate								oO-MC		x									qtz-carb	carbonate		
	269			1 blade					2											IV	1Py							x		x		carbonate	x	
	270			veins					1	3	2																							relict pumice texture
BSD 88																																		
	181.96																																	
	184.2			1	4		2		3				2		2				x	oOCH/KSo2														
	185.64			1			2		3			2	1		3		x			KSo3														
	188.63			1	4		2		3			1			1		x			KSo3														
	189.75			1			2		3			1			1					oOC										x		carbonate		feathery texture, pssibly spinifex
	191.16			1	2		3					1	trace		1					oOC														qtx veining
	192.23			2	1		3					1 sub-euh trace	dusty		1					oOC										x		carb	x	
	198.25			2	1		3		4			sub-euh	2		2					oOC													x	
	203.5												2	1	3																			
	204.96			1			2		3				trace		0	x				KSo2												carbonate		
	206.21			1	3		4		2				1		1																			
	208.55												2		2																			
	208.89			2			1					1%	1	1	3					KSo2												carbonate		
	209.53			1			2		3			4			4					KSo1												carb		carbonate chlorite veining
	209.99												2		2																			
	210.5			1			2		3			1	1		2					flowtop												carb		

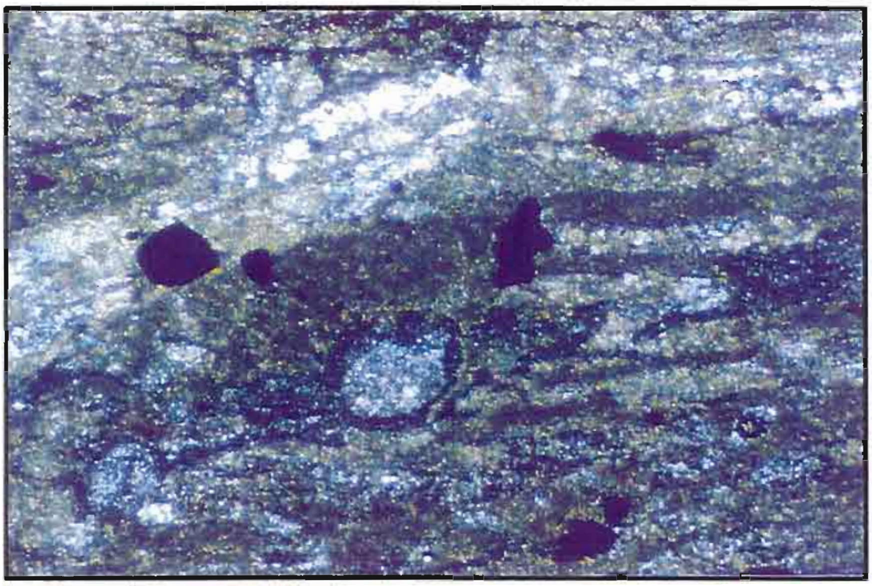


Figure 5.3a Photomicrograph in transmitted light crossed polars. Field of view is approximately 2.75mm. Sample is from hole BSD 86 at depth 184.2m within the southern flanking zone of the Black Swan Succession. Chlorite-carbonate-quartz sulphide rock after a vesicular spinifex textured flow top komatiite.

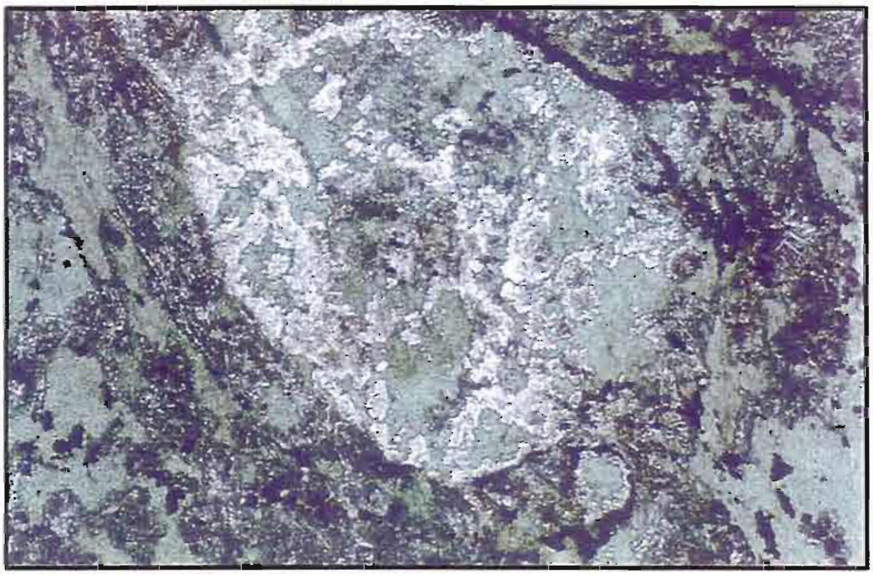


Figure 5.3b Photomicrograph in plane polarised light. Field of view is approximately 2.75mm. Sample is from hole BSD 86 at depth 208.89m within the southern flanking zone of the Black Swan Succession. Chlorite-quartz infilled vesicle (center) from a spinifex textured flow top komatiite.

As previously noted in Section 2 of this report, the main mineral assemblages observed, representing the cumulate rocks, include talc carbonate and carbonate-quartz-chlorite rocks. The carbonate takes the form of fine-to-coarse porphyroblastic and poikiloblastic grains generally within a fine-grained matrix of talc (Figure 2.8g & 5.4). Sporadic larger flakes of talc are also observed. In some of the coarse poikiloblastic grains, ghost relic lizardite mesh textures (formed during serpentinisation), rimmed by aggregates of fine-grained magnetite are observed The original olivine boundaries and hence the original orthocumulate or mesocumulates textures can be discerned from this observation (Figures 5.5 & 5.6). The magnetite abundance has a direct effect on the magnetic susceptibility of the rocks.

A black carbonate-quartz rock is observed in BSD 59 and exhibits hopper olivine textures (Figure 5.7).

Quartz forms scattered poikiloblasts, often coalescing (Figure 2.8c). Chlorite is present within the matrix taking the form of pockets composed of several grains; as individual grains; or as large optically continuous poikiloblastic blades, with inclusions of talc and carbonate (Figure 5.8). Chlorite is also often found surrounding chromite grains (Figure 5.9).

Chromite, generally rimmed by magnetite, occurs as primary cumulate grains often retaining the original lobate morphology (Figure 5.10). It is also observed as irregular grains interstitial to pseudomorphs after olivine.

Haematite is also observed in the talc carbonate rocks and occurs as discrete laths and blades (Figure 5.11 & 5.12).

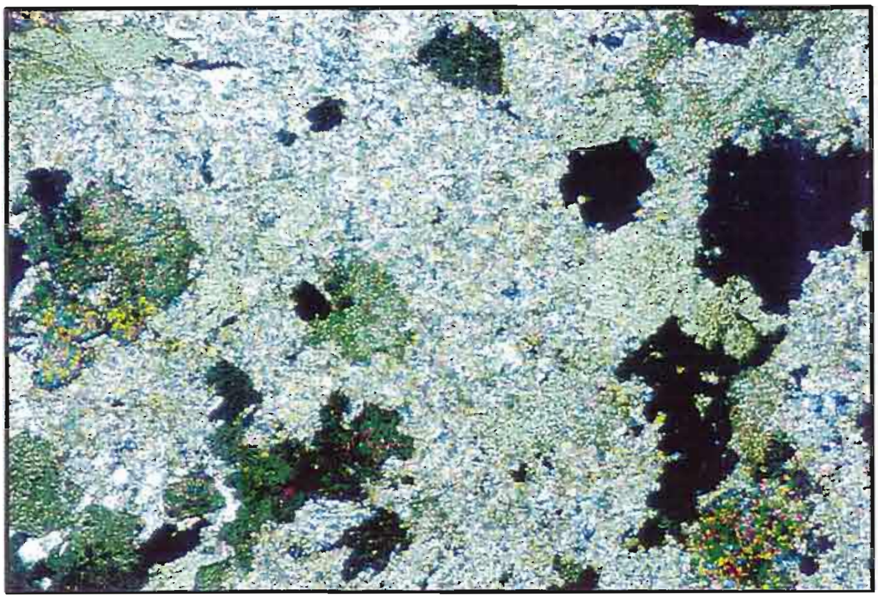


Figure 5.4 Photomicrograph in transmitted light, crossed polars. Field of view is approximately 4mm. Sample is from hole BSD 44 at depth 352m within the lower ultramafic unit, southern sector of the Black Swan Succession. Talc-carbonate-quartz rock after olivine mesocumulate.

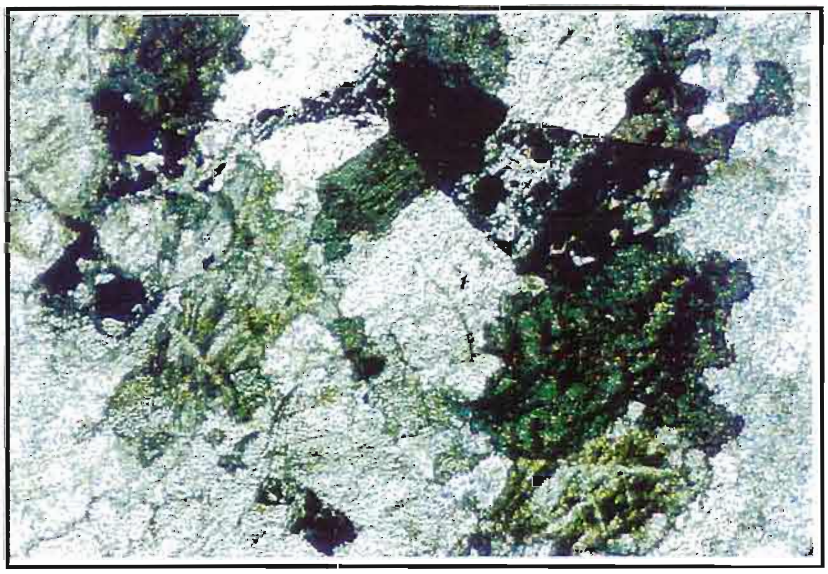


Figure 5.5 Photomicrograph in transmitted light, crossed polars. Field of view is approximately 2.75mm. Sample is from hole BSD 44 at depth 333m within the lower ultramafic unit, southern sector of the Black Swan Succession. Talc-carbonate-sulphide rock with fine grained magnetite ghosting relic lizardite mesh textures. Note sulphide (top right and left) interstitial to original primary olivines.

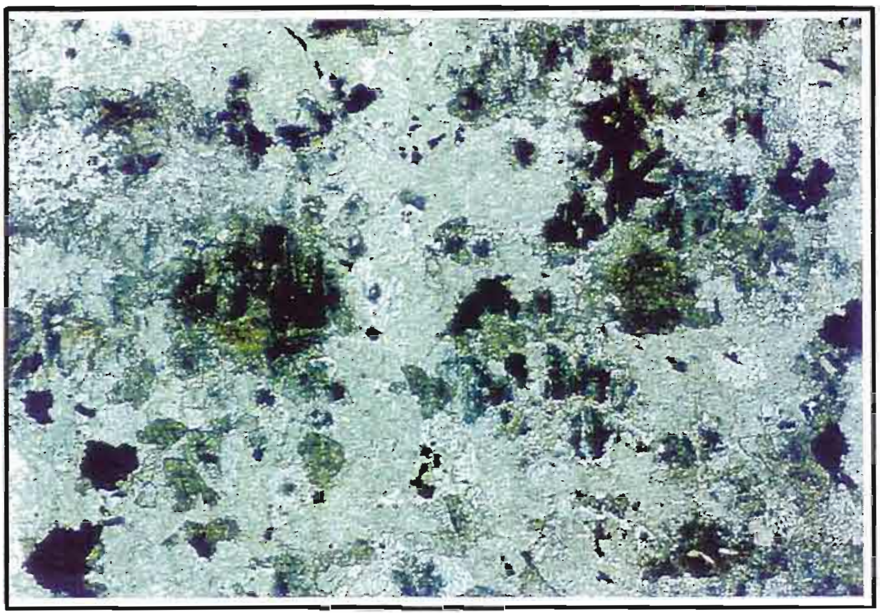


Figure 5.6 Photomicrograph in transmitted light, crossed polars. Field of view is approximately 2.75mm. Sample is from hole BSD 44 at depth 333m within the lower ultramafic unit, southern sector of the Black Swan Succession. Talc-carbonate-quartz rock. Note aggregates of fine grained magnetite ghosting relic lizardite mesh textures and larger grains of magnetite within talc matrix.

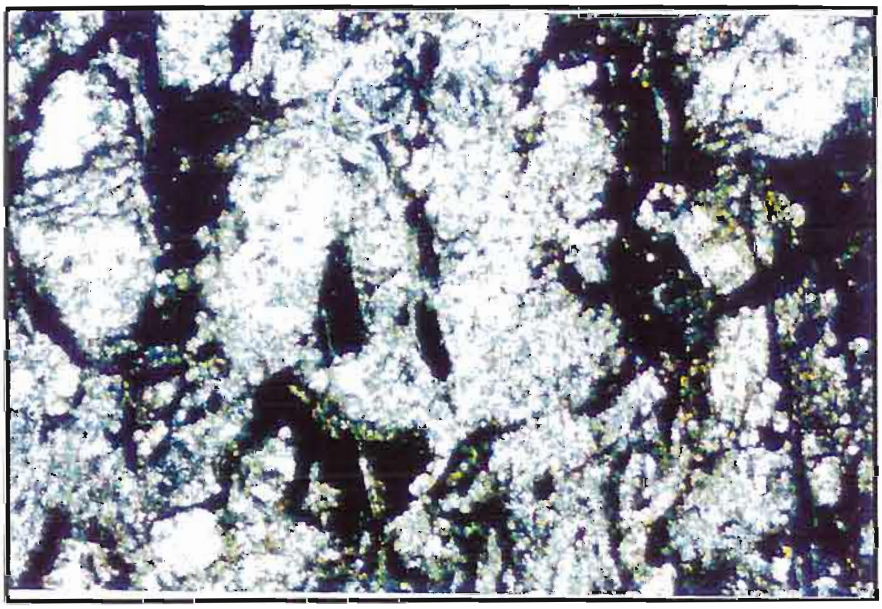


Figure 5.7 Photomicrograph in plane polarised light. Field of view is approximately 2.75mm. Sample is from hole BSD 59 at depth 269m from the lower ultramafic unit, southern sector of the Black Swan Succession. Black carbonate-quartz rock exhibiting hopper olivine textures.

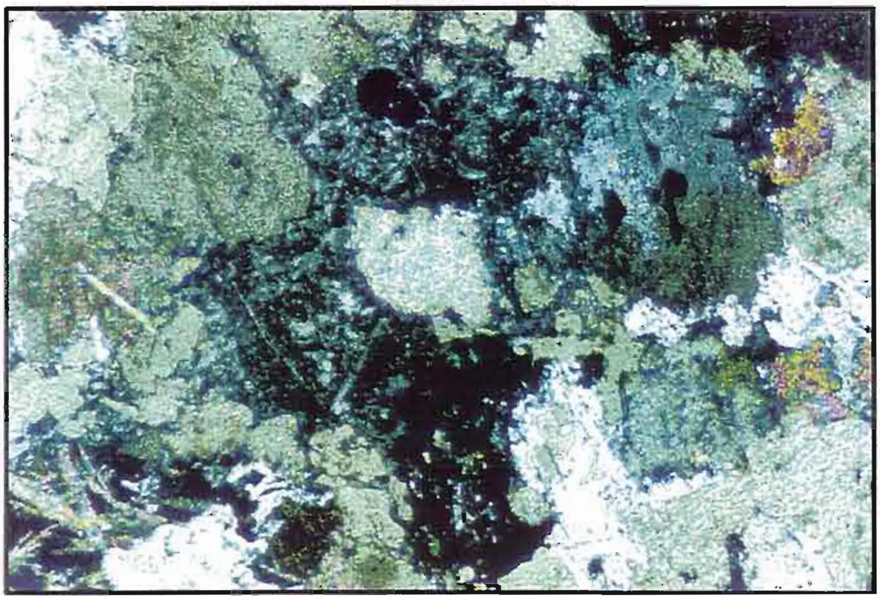


Figure 5. 8 Photomicrograph in transmitted light, crossed polars. Field of view is approximately 4mm. Sample is from hole BSD 44 at depth 301m from the lower ultramafic unit, southern sector of the Black Swan Succession. Carbonate-chlorite-talc rock. Note pockets of chlorite with inclusions of talc.

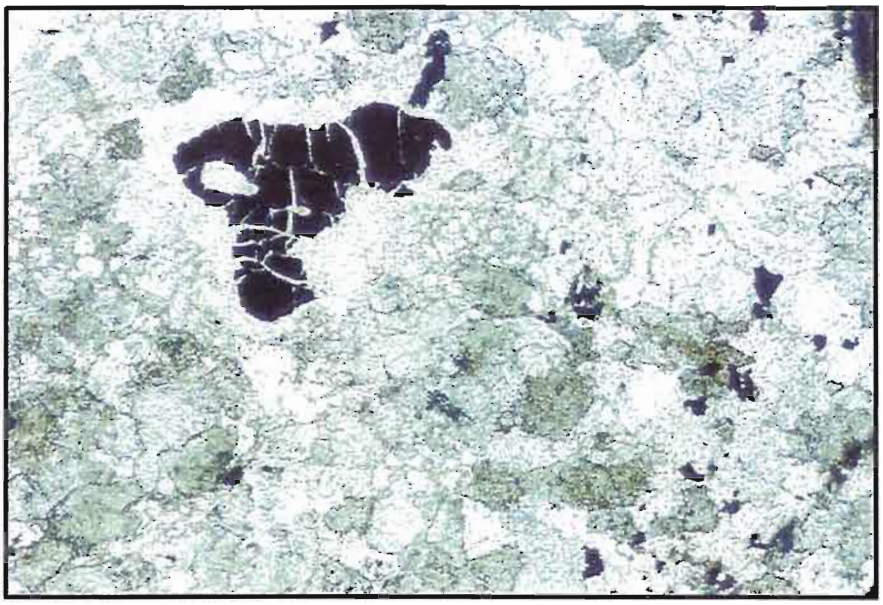


Figure 5. 9 Photomicrograph in plane polarised light. Field of view is approximately 2.75mm. Sample is from hole BSD 44 at depth 250m from the lower ultramafic unit, southern sector of the Black Swan Succession. Lobate chromite in carbonate-quartz-chlorite rock. Note cracking penetration and partial replacement of the chromite grain by chlorite.

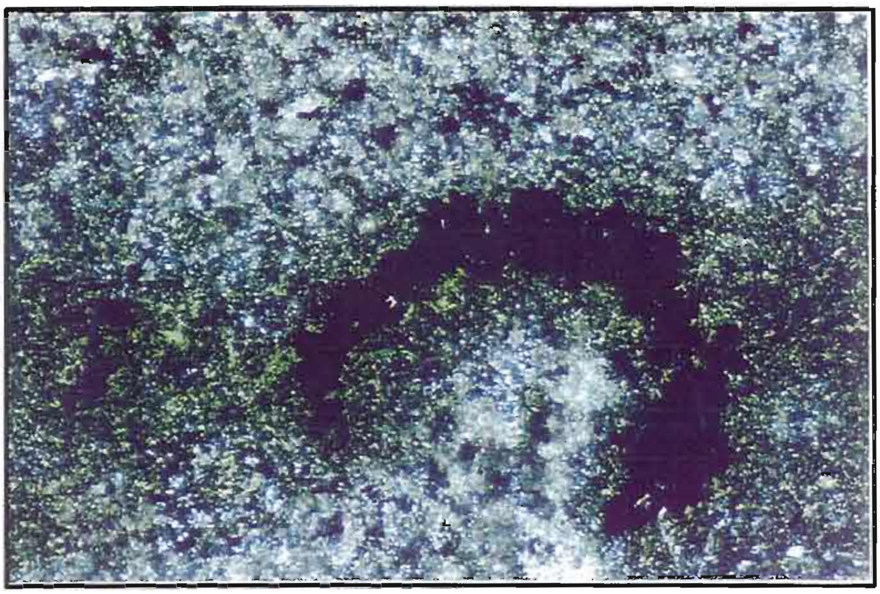


Figure 5.10 Photomicrograph in transmitted light, crossed polars. Field of view is approximately 2.75mm. Sample is from hole BSD 86 at depth 208.89m from the lower ultramafic unit, southern sector of the Black Swan Succession. Cluster of euhedral chromite in talc-carbonate altered olivine cumulate with a halo of chlorite.

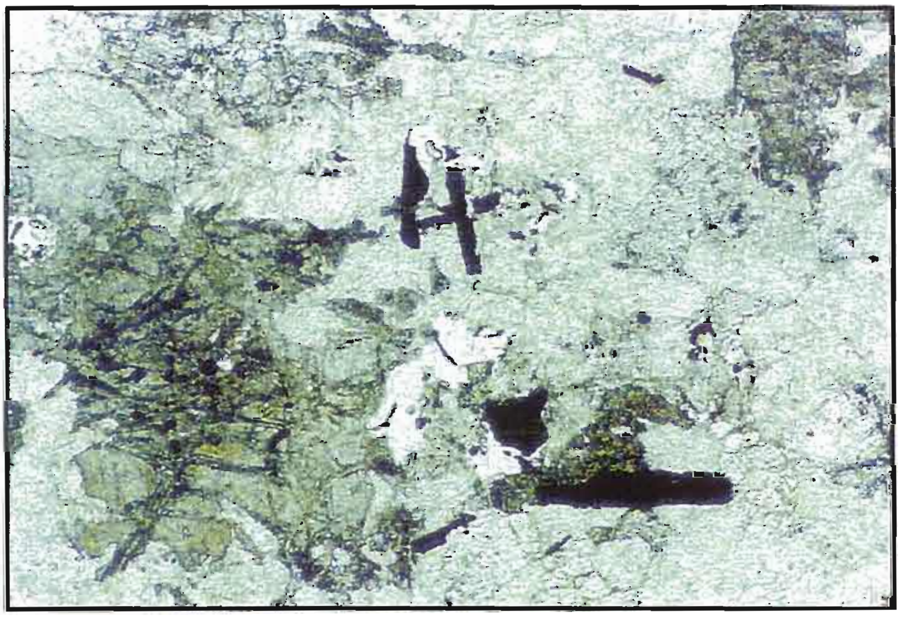


Figure 5.11 Photomicrograph in plane polarised light polars. Field of view is approximately 4mm. Sample is from hole BSD 44 at depth 284m within the lower ultramafic unit, southern sector of the Black Swan Succession. Lenticular blades and laths of hematite in talc-carbonate rock (center). Note aggregates fine grained magnetite ghosting relic lizardite mesh textures (center and bottom left) and outlining original olivine boundaries.

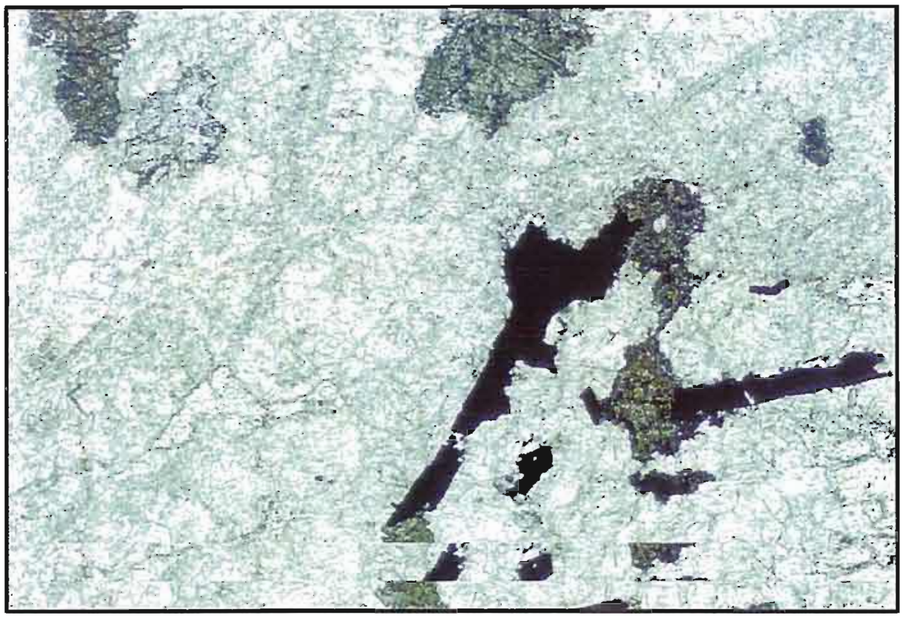


Figure 5.12 Photomicrograph in plane polarised light. Field of view is approximately 2.75mm. Sample is from hole BSD 44 at depth 284m within the lower ultramafic unit, southern sector of the Black Swan Succession. Lenticular blades and laths of hematite (black) within talc-carbonate rock.

5.2 Discussion

The textures within the hand specimen were not easily discernable and as noted above are mostly obliterated. It was originally perceived that textures would be more discernable at a microscopic scale however even at a higher level of magnification the primary olivine textures within the olivine cumulates were very difficult to distinguish. The primary mineralogy and mode was deduced by present mineralogy and ghost textures.

The mineralogies noted were as expected however the alteration appeared more pervasive.

The black carbonate quartz rock in BSD59 appears to be an irregularity within the suite representing a zone of alteration.

No magnetite was noted within the olivine spinifex rocks as was anticipated. Chromite was more abundant within the olivine sulphide cumulates and also noted within the spinifex rocks. The composition and abundance of the opaque minerals will be reflected in the geophysical properties such as magnetic susceptibility, conductivity and density.

CHAPTER SIX

Petrology and downhole geophysics

6.0 PETROLOGY AND DOWNHOLE GEOPHYSICS

Diamond core samples from the geophysically mapped intervals were taken and thin sections created. The petrography of the rocks was studied in conjunction with the measurement of physical properties and field mapping for two main reasons. Firstly, to find characteristic mineral assemblages for each main rock type, so a direct comparison could be made between rocks of similar composition, but different metamorphic grade. Secondly, the mineral assemblages need to be recognised in order to quantify any changes in density or magnetic properties of different rock types.

6.1 Statistical Approach

The downhole geophysical results from diamond holes BSD 44A and BSD 59 were plotted against mineralogical assemblage derived from petrological studies, percent magnetite content, and percent total opaque minerals present. The mineralogical assemblages were initially subdivided based on the two most abundant minerals and then further subdivided based on their entire mineralogical assemblage.

6.1.1 Percent opaques and magnetic susceptibility

No obvious relationship between estimated percent opaques and magnetic susceptibility (figure 6.1).

6.1.2 Magnetite content and magnetic susceptibility

No correlation can be seen between estimated percent magnetite content and magnetic susceptibility (figure 6.2).

Figure 6.1: Down Hole Magnetic Susceptibility & Percent Opaques

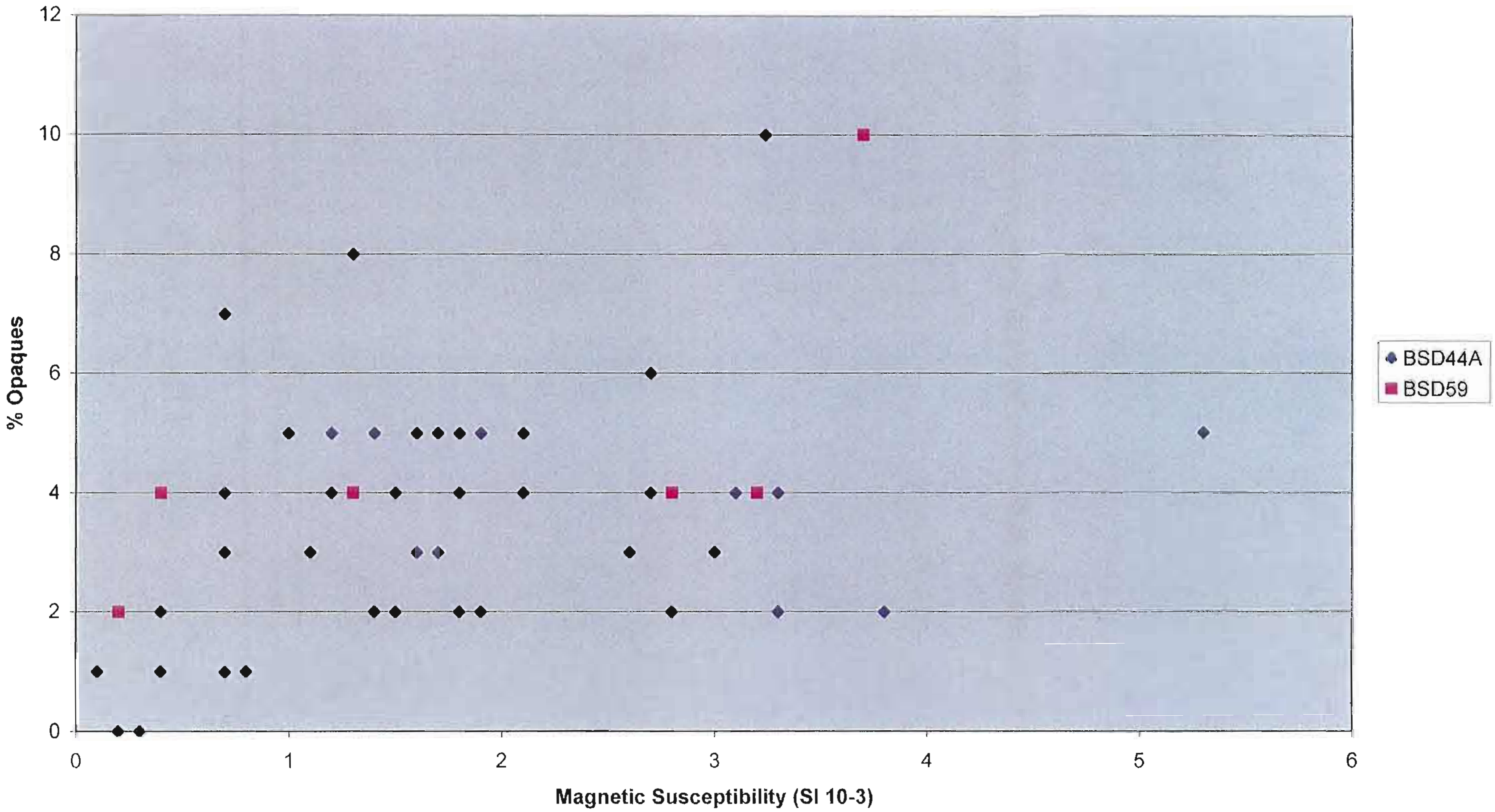
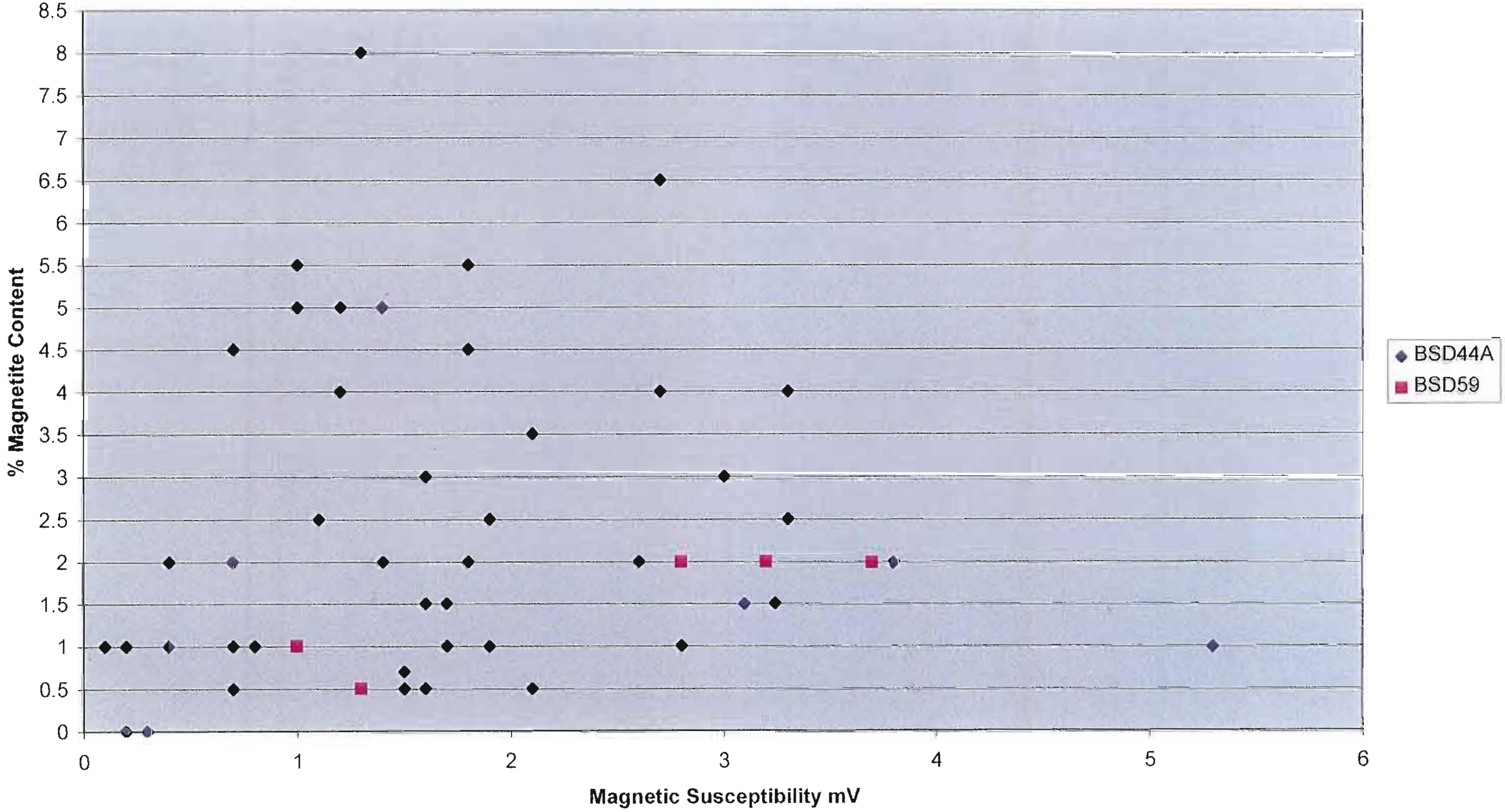


Figure 6.2 Downhole Magnetic Susceptibility & % Magnetitie Content



6.1.3 Mineralogical assemblage and gamma-gamma

Mineralogical assemblage, based on the two most abundant minerals in the rock, was plotted against downhole gamma-gamma. Two sets of assemblage criteria were used, the two most abundant minerals and the three most abundant minerals (figures 6.3a and 6.3b respectively). The inference from these results is that the rocks containing chlorite as their primary or secondary mineral abundance are less dense and less magnetic. This can also be seen with the quartz/felspar (felsic rock). Samples containing dominantly carbonate appear to be denser.

6.1.4 Mineralogical assemblage and magnetic susceptibility

The mineralogical assemblage was plotted against magnetic susceptibility. Two sets of assemblage criteria were used, the two most abundant minerals (basic) and the three most abundant minerals (figures 6.4a and 6.4b respectively). Due to the sparse nature of the sample containing chlorite it is difficult to make an accurate assessment of the impact of predominately chlorite mineralogy on magnetic susceptibility. However, these rocks including the quartz/feldspar (felsic) rocks appear to have lower magnetic susceptibilities.

6.1.5 Percent opaques and gamma gamma

A weak linear relationship is apparent between percent opaques and gamma gamma (refer to Figure 6.5). The greater the percentage of opaques in the sample, the denser the rock.

6.2 Intuitive Approach

6.2.1 Magnetic susceptibility and magnetite content

A direct correlation between magnetite content and spikes, or dramatic increases in magnetic susceptibility, is confirmed by the thin section studies. Examples taken from BSD44A are as follows:

Figure 6.3a Downhole Gamma-Gamma & Mineralogical Assemblage

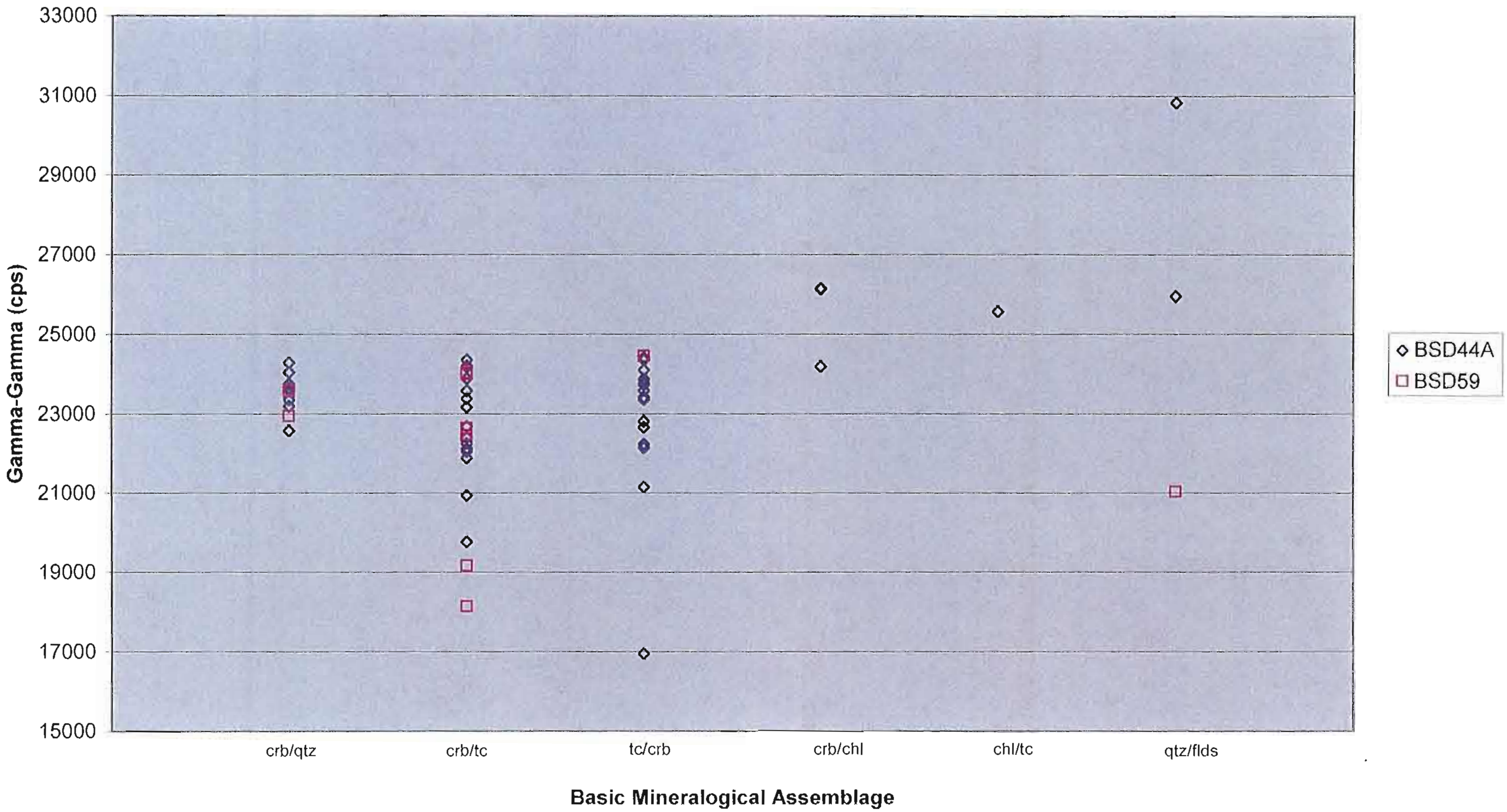


Figure 6.3b Downhole Gamma-Gamma and Mineralogical Assemblage

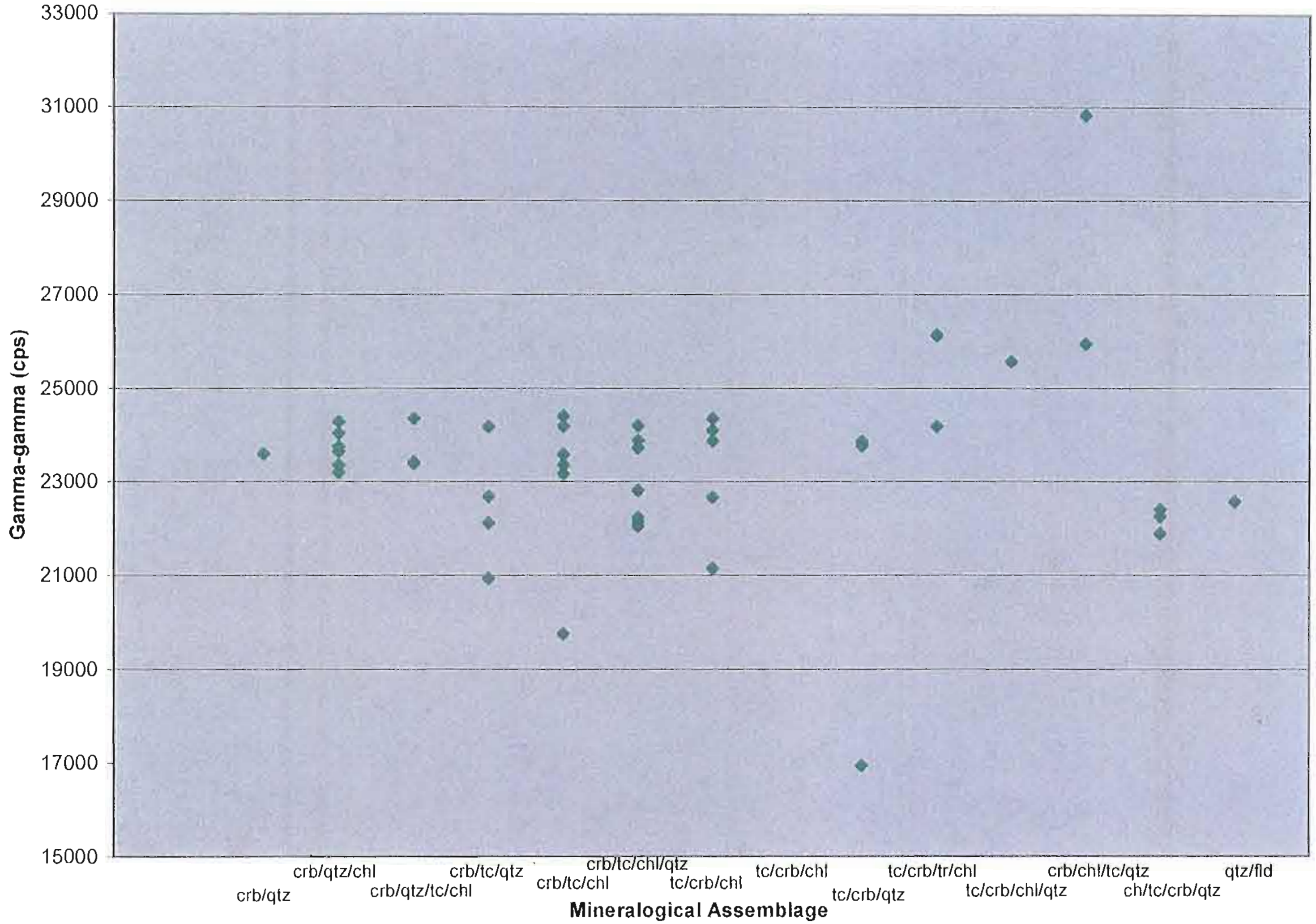


Figure 6.4a: Downhole Magnetic Susceptibility and Mineralogical Assemblage

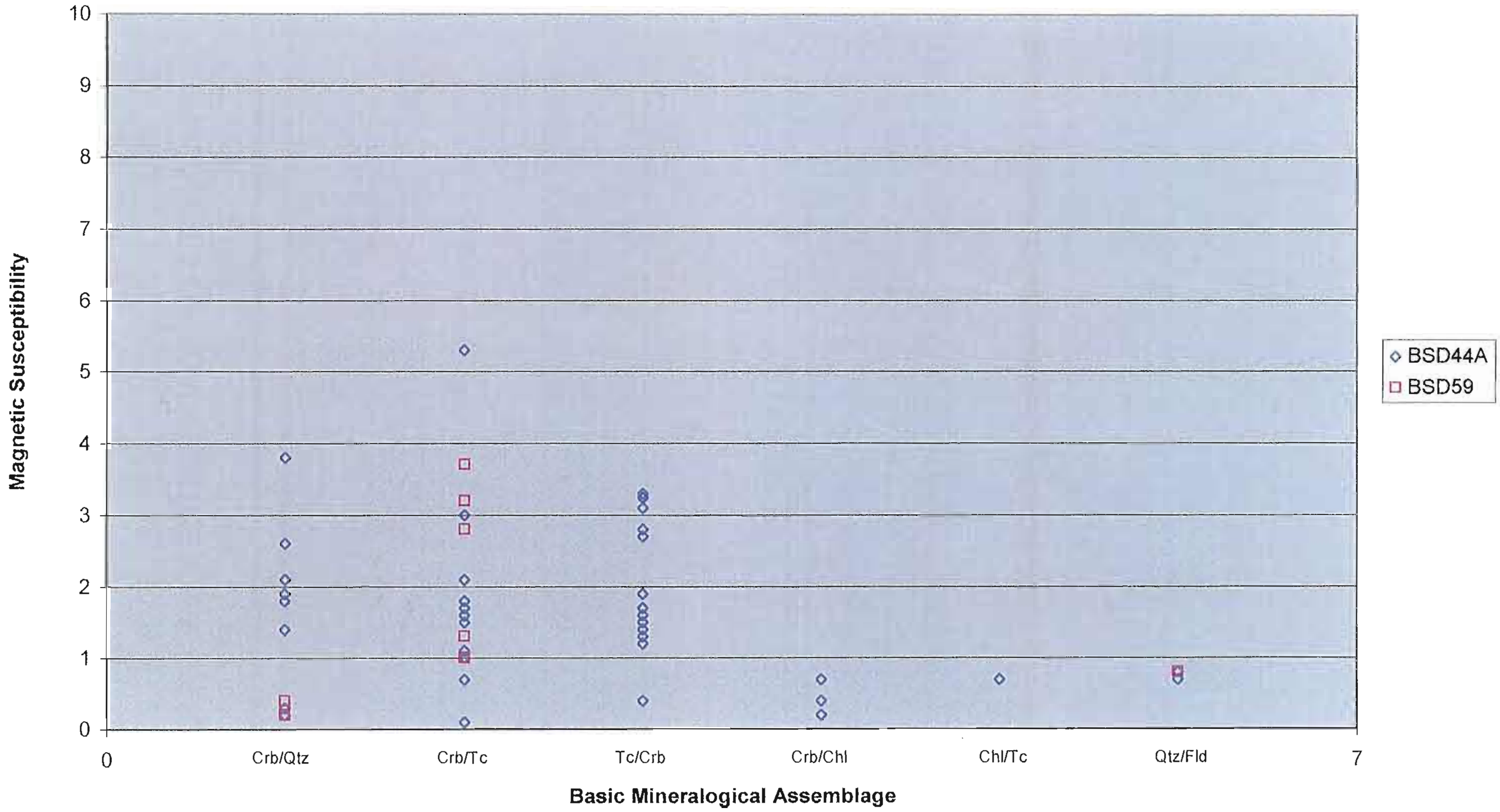


Figure 6.4b Downhole Magnetic Susceptibility and Mineralogical Assemblage

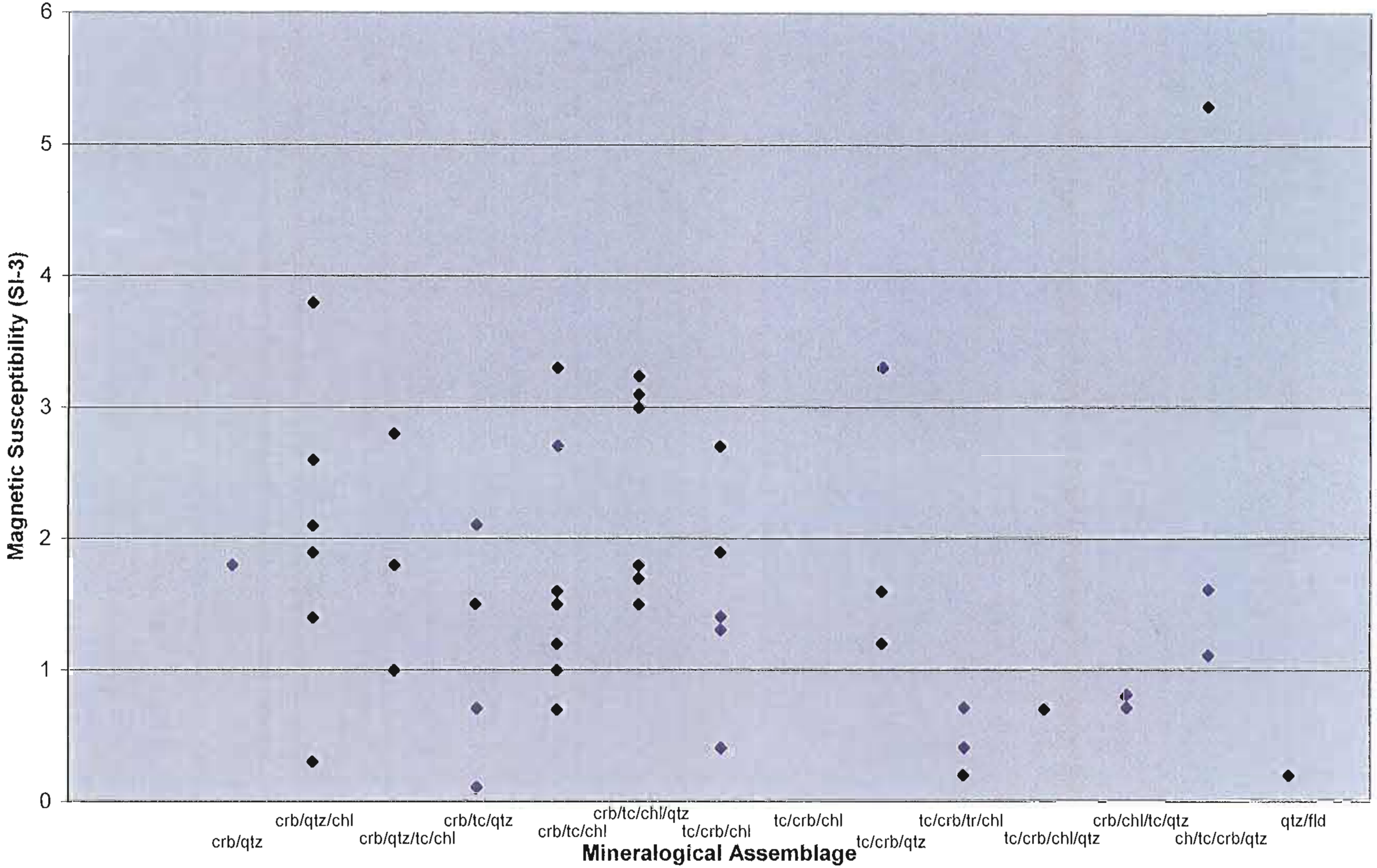
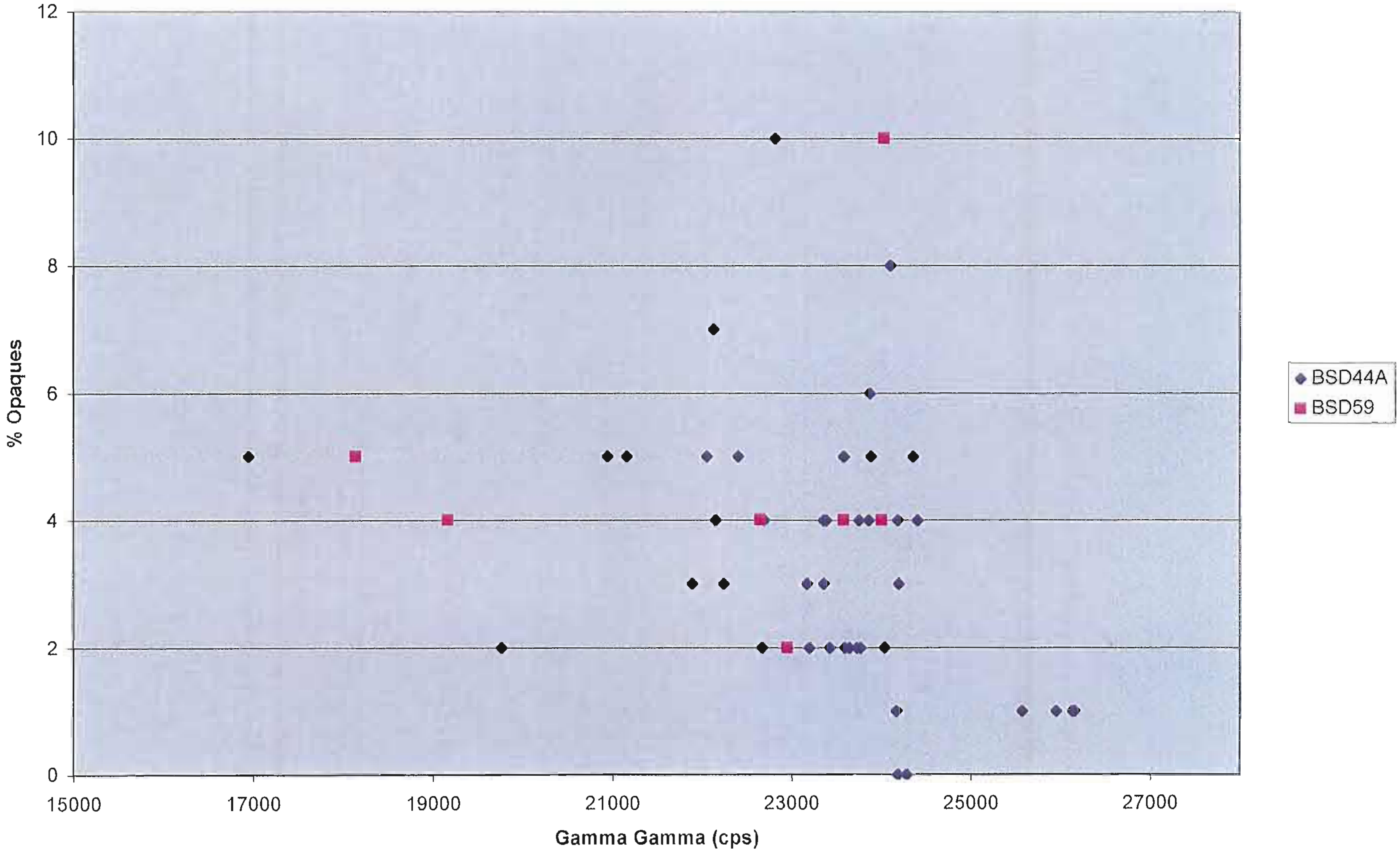


Figure 6.5: Down Hole Gamma Gamma & Percent Opaques



An increase in magnetic susceptibility and gamma-gamma marks the onset of the interval 155-159.5m. A thin section taken at a depth of 156.4m, which corresponds to a spike in magnetic susceptibility, is observed to contain 1% magnetite within an olivine cumulate rock. Again, an increase in magnetic susceptibility is observed in a thin section sample taken at a depth of 167m. 8% magnetite was o bserved in a do minantly talc-carbonate-quartz r ock. At 1 70m depth 4% magnetite was observed i n a talc-carbonate-chlorite-quartz rock. A spike in the magnetic susceptibility a t 266m may be due to the 5% magnetite observed in thin section in a dominantly talc carbonate rock exhibiting bimodal textures.

The magnetic susceptibility is erratic over the downhole interval 216-287m. Thin sections were taken from samples at depths of 223m and 227m, and are dominantly talc-carbonate-quartz rocks exhibiting bimodal textures and 6% and 4% magnetite (mainly in particle form) respectively, which may account for the spikes and the increase in magnetic susceptibility. The specimens between 227-251m are d ominantly carbonate-quartz rocks with varying degrees o f talc and chlorite, exhibiting bimodal textures. The thin sections taken also contain approximately 3% magnetite, with 1% chromite being observed at 250m depth. However, the rocks with the dominantly talc-carbonate assemblage appear to exhibit slightly lower magnetic susceptibilities whilst still containing similar amounts of magnetite.

6.2.2 Conductivity and nickel sulphide content

Dramatic increases in conductivity are observed over intervals hosting sulphides.

Over the interval 337-343.5m there is a significant increase in conductivity, which is also characterised by large spikes. Thin sections taken at 337m, 340m and 342m indicate up to 7% sulphides.

Interestingly, a sharp inverse relationship between the magnetic susceptibility, conductivity, and the gamma-gamma log occurs over the interval 343.5-345m. This inverse relationship may reflect the increase in sulphides noted in the thin sections. However, mineralogically the interval is similar to the last interval discussed above. The geochemical analysis shows the percent nickel increases from approximately 2% to 5% over this interval.

Figure 6.6 shows downhole conductivity plotted against percent nickel content and geological mine logging of the diamond core. There is a definite positive correlation between percent nickel content and conductivity. In fact, the conductivity gives a better indication of the presence of nickel sulphides in the ore then the visual mine and CSIRO geological logs.

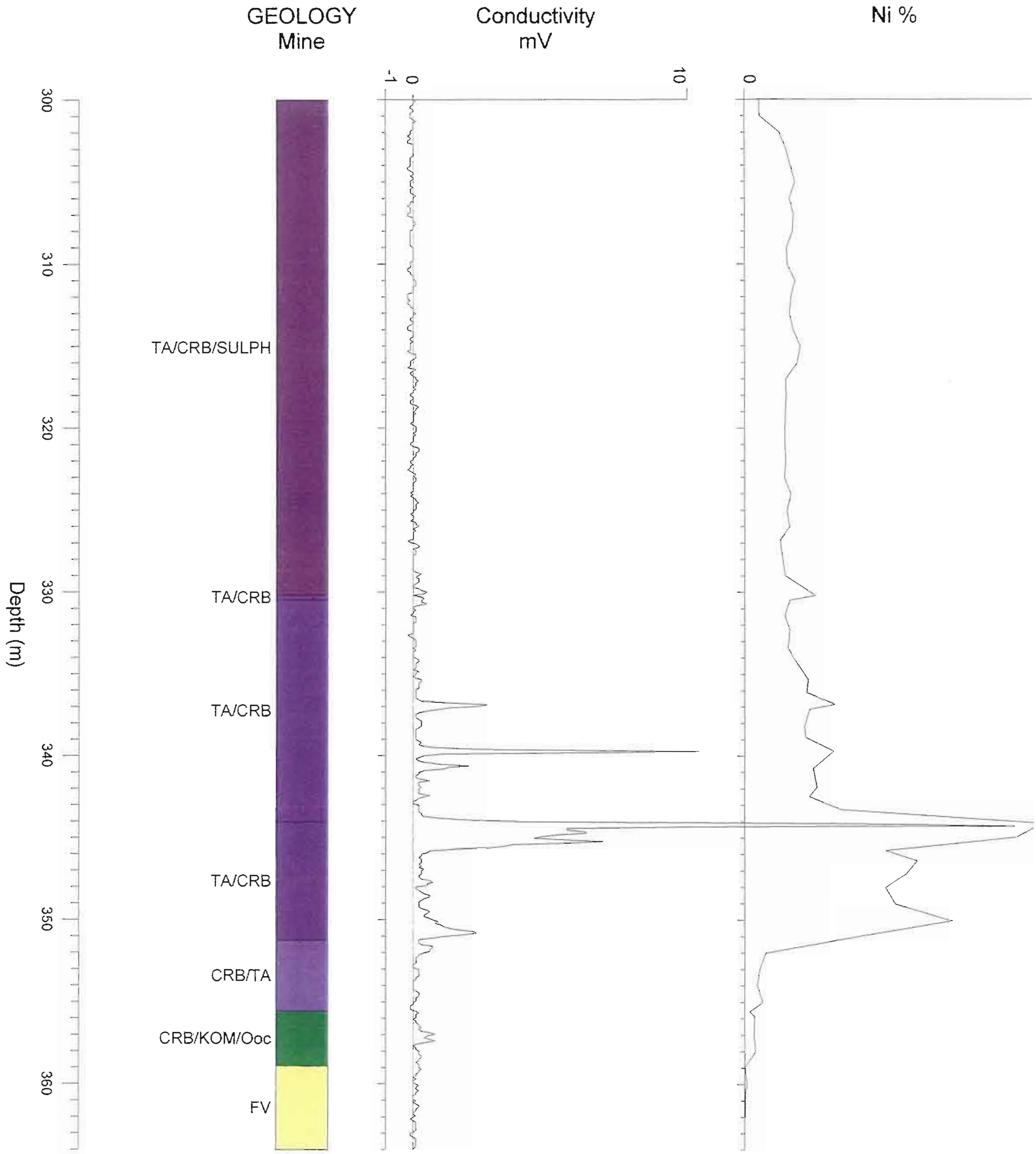
6.2.3 Gamma-gamma and percent opaques

A direct relationship can be seen, between gamma gamma and the presence of opaque minerals such as magnetite and nickel sulphide.

A direct relationship between gamma-gamma and conductivity is observed where nickel sulphides are present. A decrease in gamma-gamma (i.e. increase in density) occurs. Between the interval 345-350m, the magnetic susceptibility remains constant, however the gamma-gamma log shows lower amplitudes. The conductivity is elevated over this interval but exhibits no major spikes. An increase in sulphide content is noted within an olivine-sulphide orthocumulate represented now by a dominantly carbonate-talc assemblage.

A decrease in the gamma-gamma logs and a large increase in conductivity also characterises the interval between 350-352m. The upper boundary of this interval correlates to the geological boundary and supposedly marks the end of mine geologist logged nickel sulphides, however a large positive spike in the conductivity would

Figure 6.6
BSD 44A
Conductivity and Nickel Content (%)



suggests the opposite. Cross-referencing with geochemical assays indicate that there are nickel sulphides present at the geochemical boundary at 353.12m depth.

6.2.4 Gamma-gamma, magnetic susceptibility, conductivity and mineralogical assemblage

Mineralogical changes can be observed throughout the geophysics as discussed previously and are evident again in the thin section studies. Over the interval 145-146.5m there is a direct correlation between the geological logs, and the conductivity and gamma-gamma logs, where there is a small increase in the magnetic susceptibility, but a sharp drop in the conductivity and gamma-gamma logs. A thin section from 145.6m confirms the geological logging as an ultramafic unit. Chlorite-filled vesicles are evident in thin section and the mineralogy consists of chlorite-talc-carbonate-quartz.

Original textural differences have also been observed and differentiated by the geophysics. A geophysical boundary is noted at 356m. A decrease in the magnetic susceptibility, a sharp decrease in the conductivity, and an increase in the gamma-gamma log occur. This zone corresponds to the lower boundary of the sago-textured olivine orthocumulate rocks as logged by CSIRO and confirmed by thin section analysis of sections taken at depths of 354m and 357m.

<u>BSD 44A 359m</u>

This boundary correlates with the geological boundary between ultramafic and the felsic footwall rocks as logged by both the mine geologist and CSIRO. A sharp large increase in the gamma-gamma, and a moderate decrease in the magnetic susceptibility and conductivity denote this contact.

6.3 Discussion

No correlation can be seen between the estimated percent of magnetite content and magnetic susceptibility, or between estimated percent opaques and magnetic susceptibility, and this was not an expected result. However, using the intuitive approach there appears to be obvious correlations between spikes in the magnetic susceptibility and an increase in the percent magnetite in thin section. Examples include thin sections taken at the following depths: BSD 44a: 156.4m, 170m, 174m, 223m, 268m and 275m, and from BSD 59 at 240m, to name but a few. Human error relating to the estimation of percentages may be partly to blame, and another computer-based estimation processes may be more accurate.

Magnetic susceptibility is a function mainly of magnetic oxide content, and hence primarily magnetite content. Magnetite content is in turn dependent upon original host rock geochemistry and oxygen fugacity (Haggerty, 1979; Grant, 1985; Clark *et al*., 1992). Alteration processes, particularly in ultramafic rocks (Donaldson, 1981; 1983), can further modify the magnetite content and therefore the magnetic properties of greenstones. Serpentinisation, talc-carbonate alteration and secondary solution processes alter the original oxide distribution. As documented by Belairs (1979) there is a direct positive relationship between magnetic susceptibility and volume percent magnetic oxides. See Figure 6.7.

Metamorphic / alteration reactions that lead to the creation and destruction of magnetite within ultramafics are as follows (after McQueen, 1981a). These reactions are discussed at length by Donaldson (1981, 1983) and are also summarised by Robson (1991):

<u>Magnetite constructive: Serpentinisation</u>

$$20Mg_{18}Fe_{0.2}Si0_4 + 21.2H_20 = 10Mg_3Si_20_3\,(OH)_4 + 1.3\,Fe_30_4 + 610\,Mg0_{10} + 2.4H_2$$

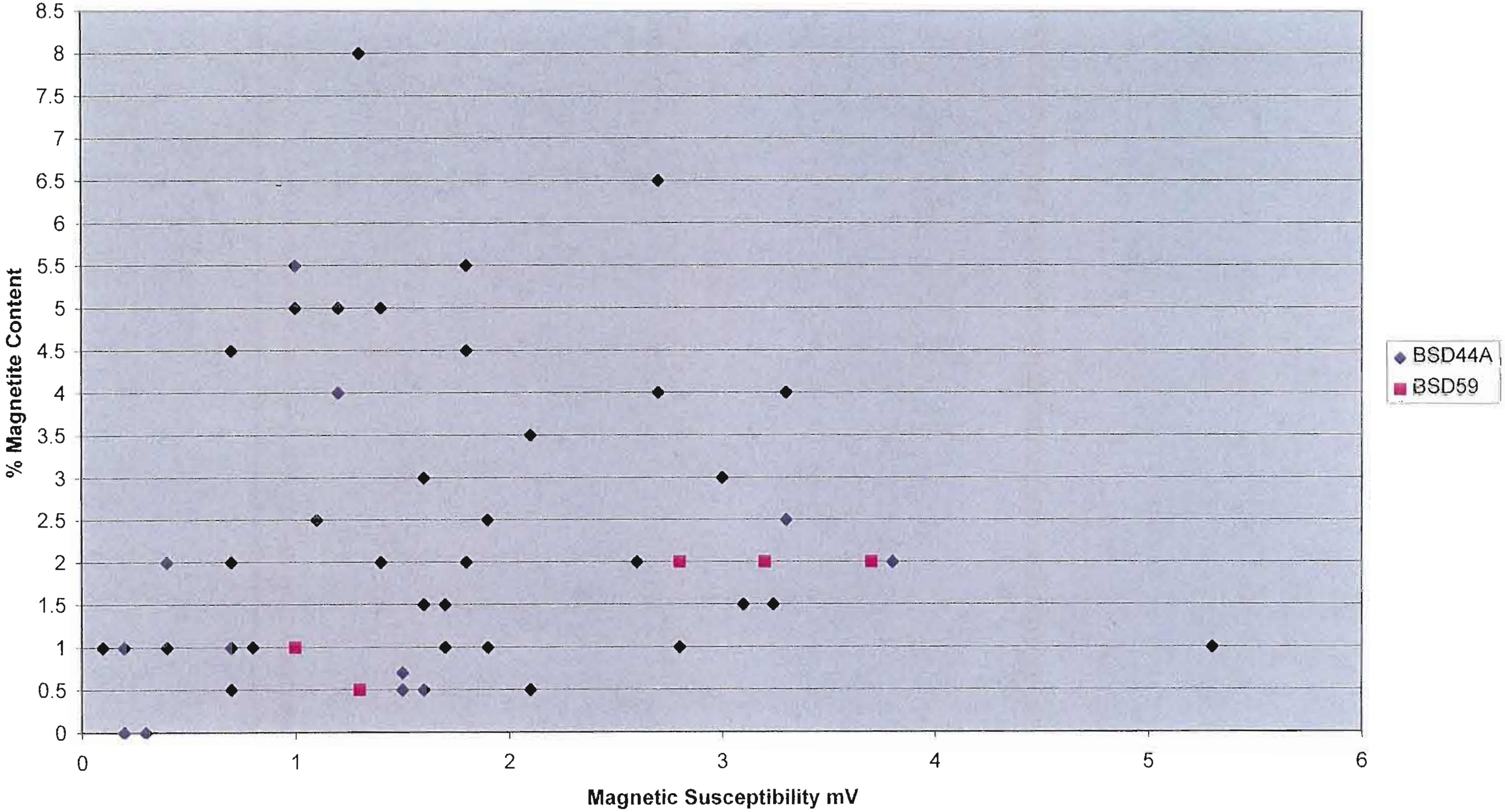
(olivine) (fluids) (serpentine) (magnetite) (in brucite/chlorite)

or,

$$20Mg_{18}Fe_{0.2}Si0_4 + 21.2H_20 = 10Mg_3Si_20_3\,(OH)_4 + 1.3\,Fe_30_4 + 610\,Mg0_{10} + Fe$$

(olivine) (fluids) (serpentine) (magnetite) (in brucite/chlorite) (into sulphide)

Figure 6.7 Magnetic Susceptibility & % Magnetite Content



Magnetite destructive: Talc-carbonate alteration

$$18Mg_3Si0_5(OH)_4 + Fe_30_4 + 30C0_2 = 9Mg_3Si_4O_{10}(0H)_2 + 30Mg_{0.9}Fe_{0.1}CO_3 + 27H_20 + 0.50_2$$

(serpentine) (magnetite) (talc) (magnesite)

As all the above reactions are dependent upon the initial chemistry of the ultramafic unit, subtle changes in chemistry that are diagnostic to mineralised flows (see Williams & Brand, 1992) may therefore be reflected in the magnetic signature. The influence of talc-carbonate alteration is likely to be more prevalent at greenschist facies conditions due to the decreasing stability of carbonate minerals with increasing temperature (Yardley, 1989). Given that the initial chemistry is a reflection of the initial mineralogy, any change in the mineralogy will also reflect a change in magnetic signature. If the thicker ore-bearing ultramafics are more olivine-enriched than their laterally equivalent flanks, and the whole package is uniformly serpentinised and/or subject to carbonate alteration, subsequent construction and/or destruction of magnetite would yield a net predominance of magnetite where there was initially a greater proportion of olivine.

A weak linear relationship is apparent between the percent opaques and gamma gamma (refer to Figure 6.5). The greater the percent of opaques, the denser the rock. This was an expected result as opaques have higher densities than the other minerals, which make up the rock.

The rocks containing chlorite as the primary or secondary most abundant mineral are less dense and less magnetic. This can also be seen with the quartz/felspar (felsic rock). This could possibly be due to the fact these rocks also contain no magnetite. Unfortunately the data is sparse for these rock types. These rocks are interpreted as the spinifex-textured rocks formed on the flanks of a volcanic trough. The samples containing dominantly carbonate appear to be denser and their protoliths are described as olivine orthocumulate rocks.

Due to the high density of magnetite (5.2g/cm^3), changes in magnetite content may affect the density. Olsen *et al.* (1991) and Henkel (1976) have also noted magnetite distribution affecting the density of similar rock types.

Chromite is an accessory component in olivine spinifex-textured rocks and in olivine-rich cumulates. Its texture varies systematically with rock type and volcanic environment (Barnes, 1998).

Barnes (1998) concluded that the abundance and textural habit of cumulus chromite in Komatiite cumulates shows a correlation with volcanic facies. Channelised flows commonly contain low abundances of cumulus chromite, due partly to high-Mg lava compositions, and possibly to unusually reduced magma compositions, and resulting high chromite solubilities.

Studies of the modification of chromite during alteration and metamorphism of Komatiite rocks (Bliss & MacLean, 1975; Donaldson, 1983; Gole & Hill, 1990) highlight two important effects. Firstly, chromites become rimmed and progressively replaced by chromium magnetite (or 'ferrichromite'). Secondly, as a result of exchange of the major elements Mg, Fe, Al and Cr with surrounding silicate minerals such as olivine, pyroxene and chlorite (Evans & Frost, 1975), chromite core compositions become progressively modified during prograde metamorphism (Barnes, 1998). Incipient alteration and growth of magnetite rims and veins result due to the introduction of these elements from hydrothermal fluids.

Variation in chromite content affects the composition of the oxide phase within the now altered and metamorphosed rocks. Hence, the bulk magnetic susceptibility of the rocks can be affected by the earlier chromite distribution.

An additional mode of occurrence of chromite and Cr-bearing magnetite-rich spinel is within massive Fe-Ni sulphides (Groves *et al.*, 1977; Barnes *et al.*, 1988a; Frost & Groves, 1989a; Lesher, 1989; Barnes, 1998).

CHAPTER SEVEN

Discussion and Conclusion

7.0 DISCUSSION AND CONCLUSIONS

The aim of this study is to geophysically typecast Komatiite flows hosting mineralisation so to discriminate the trough from the flanks of a potentially mineralised channel thus providing vectors to nickel sulphide mineralisation.

The objective was to find a unique relationship between original rock types and current physical properties using measurements taken on diamond drill core and down hole logging, because primary rock type (protolith) are not easily recognised in hand specimen. A classification scheme based on present mineralogy, indicative of protolith, was used in an attempt to relate physical properties such as magnetic susceptibility, conductivity and specific gravity data to lithology. This proved to be difficult, as the variable metamorphic influences within the Black Swan Succession have resulted in wide ranging and inhomogeneous mineralogical assemblages, with complex distribution and composition of magnetic oxide minerals.

Magnetic susceptibility, inductive conductivity, resistivity, natural gamma and gamma – gamma measurements were made using the OMS-LOGG system. Diamond holes BSD 44A, BSD 59 and BSD86 were chosen to represent both trough and flanking environments within a Komatiite lava pathway establishing relationships between petrophysical properties and Komatiite textures and petrology. These measurements, together with geological core logging, were used as a bias to select specimens for detailed petrographic studies. The selected specimens covered a wide range of rock types, Komatiite textures and susceptibilities, densities and conductivity including specimens from both the ore and host lithologies. The representative core samples were described geologically, mineralogical and geomechanically.

Manual measurement of magnetic susceptibilities, specific gravity and conductivity were also taken over a selected suite of BQ diamond core samples from a number of holes that covered a wide range of rock types

The rocks have been geologically logged in terms of present mineralogy and interpreted primary mineralogy (protolith) by the mine geologist and CSIRO respectively. The results of the study were reviewed using an intuitive and statistical approach.

7.1 Discussion of Results

The Black Swan Succession can be broadly divided into four main rock types by their current mineralogy, quartz-chlorite, quartz carbonate, serpentinite and talc-carbonate, which exhibit relict spinifex and cumulate textures. These rocks are poorly exposed and where outcropping consist of weathered silicified massive serpentinite exhibiting relic cumulate textures. The quartz chlorite rocks represent the original olivine spinifex rocks, with the remaining rocks types representing olivine ortho-mesocumulate protolith.

The textures within the hand specimen were not easily discernable and were generally obliterated. Even at microscopic scale the primary olivine textures are very difficult to distinguish. The primary mineralogy and hence protolith was deduced by the present mineralogy and ghost textures. It was hoped that some petrophysical characteristic of the protolith was preserved to help identify the actual position in the Succession.

Airborne magnetic surveys were useful in indicating the presence of magnetic ultramafic lithologies. The Black Swan Komatiite manifests itself as a magnetic high especially when serpentinised. No facing directions could be inferred from magnetic data nor could the presence of Komatiite channels because of the carbonate alteration. The regional gravity survey was also useful in locating the ultramafic lithologies. Hence both geophysical methods could be considered a vector towards the correct basic volcanological environment. However this tool could not be used to focus on the presence of a magmatic nickel sulphide orebody.

Traditional surface geophysical exploration methods have proven to be of little use in targeting magmatic nickel sulphides within the Black Swan Succession. Ground magnetic and gravity surveys were deemed superfluous due to nature of the weathering profile. No ground electromagnetic anomalies could be directly attributed to a response from the massive nickel sulphides. DHTEM was noted as the most useful tool in directional deep drilling and to sterilise the target basal contact around each of the barren holes.

There is commonly no distinct variation in magnetic signatures between the Komatiites and the felsic volcanic rocks with the Black Swan Succession, however the conductivity of the rocks will indicate the presence of magmatic nickel copper sulphides. Variation in densities of the rocks has not been studied in detail and requires further consideration.

As expected the serpentinites exhibited the highest susceptibility and the greatest range. The talc carbonate rocks showed varying susceptibilities, which varied qualitatively from low to medium. The massive sulphide samples also exhibited a range of susceptibilities from low to medium with the exception of one high reading. The olivine spinifex, pyroxene spinifex and felsic rocks showed relatively low susceptibility over a restricted range. However, the ranges for the rock types were similar and hence could not be used for identification. The mean magnetic susceptibility values of the felsic rocks were similar to some of the olivine cumulate rocks, which is not what one would generally expect. This is probably due to the pervasive alteration evident in the Black Swan area resulting in magnetite destruction.

The highest conductivities, as was expected, was exhibited by the ore hosting lithologies. The spinifex-textured flow rocks exhibit the lowest conductivities. The olivine cumulate and felsic rocks have varying conductivity ranges.

The felsic rocks are least dense rock type with the olivine cumulate rocks hosting the disseminated sulphides being the densest. The opaques, in particular the sulphides is the most probable reason for this phenomenon. Hence the mineralised channels (troughs) are denser than the footwall rocks.

The rocks containing chlorite as the primary or secondary most abundant mineral are less dense and less magnetic which could possibly be related to the lack of magnetite found in these rocks. These rocks are interpreted to have been spinifex-textured rocks formed on the flanks of a volcanic trough. The samples containing dominantly carbonate appear to be more dense and there protoliths are described as olivine orthocumulate rocks. Thus the flanking ultramafic rocks are less dense than the channelised ultramafic rocks.

The composition and abundance of the opaque minerals is expected to be reflected in geophysical properties such as magnetic susceptibility, conductivity and density. However, it was found that statistically no correlation could be seen between estimated percent magnetite content and magnetic susceptibility or between estimated percent opaques and magnetic susceptibility. The intuitive analyses approach yields a more expected result, as there appears to be obvious correlations between spikes in the magnetic susceptibility and increase in the percent magnetite noted in thin section. The statistical approach may have been inaccurate due to human error in estimating percentages and perhaps a computer based estimation process may be more accurate.

A weak inverse linear relationship is apparent between percent opaques and gamma gamma that is, the increase in percent opaques the denser the rock which was expected as the opaques, magnetite, nickel sulphide, haemetite and chromite have higher densities than other minerals making up the rock.

7.2 Conclusions

In theory geophysics should be a more reliable tool for logging core since it provides a repeatable objective method of lithological discrimination, however this study shows that the detailed logging at hand specimen and at microscopic scales is generally more reliable in this altered environment. Given that during exploration such specialised logging is not permitted the geophysics can be used as a further qualitative tool to identify and bring to the attention of the mine geologist subtle changes within units.

The net magnetisation of the ultramafic results from the interplay of the magnetite constructive and –destructive reactions. Geological processes, which have led to the crystallisation/destruction of magnetite with in the Black Swan area, include metamorphism, serpentinisation and hydrothermal alteration. A lesser control is the primary pyrrhotite content of the ultramafics.

As these reactions are dependent upon the initial chemistry of the ultramafic, subtle changes in chemistry that are diagnostic to mineralised flows (see Williams & Brand 1992) may therefore be reflected in the magnetic signature. Given the initial chemistry is reflecting the initial mineralogy, any change in the mineralogy will also reflect a change in magnetic signature. Such a change in the magnetic signature could well be expected when comparing "flanking" ultramafic typically characterised by thinner spinifex textured, lower MgO flows with channel ultramafics characterised by olivine rich (hence higher MgO) cumulate textures.

If a package of "flanking" and thicker potential ore bearing channel ultramafics is uniformly serpentinised and/or subject to carbonate alteration, subsequent construction and/or destruction of magnetite would yield a net predominance of magnetite where there was initially a greater proportion of olivine. That is, there would be a greater concentration of magnetite per unit volume in the channel positions (which are olivine enriched) compared with flank positions. Within the proximal ore environment, monoclinic pyrrhotite may augment the total magnetisation of the ultramafic.

Also, due to the high density of magnetite (5.2g/cm^3), changes in magnetite content may affect the density. Olsen *et al.* (1991) and Henkel (1976) have also noted magnetite distribution affecting the density of similar rock types. Thus the trough positions originally occupied by olivine cumulate rocks should be more dense than the flanks made up originally of spinifex which now contain no magnetite.

However the magnetic properties of the rock depend not only on the primary rock composition and fabric, the degree of serpentinisation but also on the type and intensity of alteration – (talc-carbonate / surface alteration) the type and intensity of metamorphism. The pervasiveness of the alteration and metamorphism at Black Swan is variable thus making it difficult to typecast a Komatiite flow and hence provide a vector to the nickel sulphide mineralisation. Other areas within the Yilgarn Craton, which have not undergone such intense alteration, would be able to use the techniques described above as vectors in the search for mineralisation.

As noted above there is commonly no distinct variation in magnetic signatures between the Komatiites and the felsic volcanic rocks with the Black Swan Succession. The conductivity of the rocks will indicate the presence of magmatic nickel copper sulphides. Variation in densities of the rocks has not been studied in detail and requires consideration.

Given the expense of close spaced drilling programs, and the necessity for high cost diamond drilling to elucidate geology, structure and mineralisation in areas of limited outcrop, geophysical techniques could significantly reduce exploration costs.

To fully understand the relationship between rock types and physical properties a more detailed study of the geochemistry such as an analysis comparing the MgO content of the rocks to the physical properties is recommended. This was not attempted during the course of this study, due to the cost constraints.

Another factor that would contribute towards a better understanding of the magnetics and density is a more detailed analysis of opaque mineralogy, firstly to determine accurate proportions of the relevant minerals. Magnetite could be examined using a scanning electron analysis to determine variations, if any, in chemical composition.

References

AMANN, W.A., & PIETILA, R., 1998. Geophysical response of the Silver Swan nickel sulphide deposit Western Australia, In. Exploration Geophysics 29, 273-279.

ARNDT, N.T., & NISBET, E.G., 1982. What is a Komatiite?. In: Arndt N.T. and Nisbet, E.G. (eds.) Komatiites, George Allen and Unwin, London, pp.19-28

BARNES, S.J., GOLE, M.J. 7 HILL, R.E.T., 1988A. The Agnew nickel deposit, Western Australia; part I. Stratigraphy and structure. Economic Geology **83**, 305-331.

BARNES, S.J., HILL, R.E.T. & PERRING, C.S., 1994. The classification and volcanological setting of Komatiite-hosted nickel sulphide deposits. In: Australian Research on Ore Genesis Symposium, 5.1-5.5 (Australian Mineral Foundation: South Australia).

BARNES, S.J., 1998. Chromite in Komatiites, 1. Magmatic controls on crystallisation and composition. Journal of Petrology **39**, 1689-1720.

BELLAIRS, P., 1979. A geophysical study of the Kathleen East Nickel Prospect, Western Australia: with special reference to the physical (magnetic and mineralogical) properties of ultramafic rocks. B.Sc. (Hons.) Thesis, Geol. Dept., Univ. West. Aust. (unpublished).

BERRY, M. & PITKAJARV, J., 1197 Application of Borehole Logging to underground mining and Grade control practices, Australian Institute of Geoscientists Bulletin No. 19.

BLISS, N.W. & MACLEAN, W.H., 1975. The paragenesis of zoned chromite from central Manitoba. Geochimica et Cosmoschimica Acta **39**, 973-990.

BOURNE, B., The effect of metamorphic grade on the geophysical signature of Western Australian greenstone belts. A comparison of greenschist and amphibolite facies. B.Sc. (Hons.) Thesis, Geol. Dept., Univ. West. Aust. (unpublished).

BOURNE, B.T., DENTITH, M.C., TRENCH, A., & RIDLEY., 1993. Physical Property Variations within Archaean Granite-Greenstone Terrane of the Yilgarn Craton, Western Australia: the influence of metamorphic grade, Exploration Geophysics (1993), **24** 367-374.

CLARK, D.A., 1983. Comments on magnetic petrophysics. Bull. Aust. Soc. Explor. Geophys., **14**, 49-62.

CLARK, D.A., FRENCH, D.H., LACKIE, M.A., & SCMIDT, P.W., 1992. Magnetic petrology: application of integrated rock magnetic and petrological techniques to geological interpretation of magnetic surveys. Explor. Geophys., **23**, 65-68.

CLARK, D.A. & EMERSON, D.W., 1991. Notes on rock magnetisation characteristics in applied geophysical studies. Exploration Geophysics, **22**,. 547-555.

DANIELS, J.J., & MULLER, D.C. 1989. Geophysical well logging above the water table. In: Proceedings of Exploration '87. Third Decennial International Conference on geophysical and Geochemical exploration for Minerals and Ground Water, 655-664. Ontario G

Geological Survey Special Volume 3.

DONALDSON, M.J., 1981. Redistribution of ore elements during serpentinisation and talc-carbonate alteration of some Archaean dunites, Western Australia. Economic Geology, 76, 1678-1713.

DONALDSON, M.J., 1983. Progressive alteration of barren and weakly mineralised Archaean dunites from Western Australia. Unpublished Ph.D. Thesis, University of Western Australia, Nedlands. 345pp.

DOWLING, S.E., & HLL, R.E.T., 1998. Komatiite-hosted nickel sulphide deposits, Australia. In: Ian Hodgson (editor), AGSO Journal of Australian Geology and Geophysics, Volume 17, Number 4, 121-126.

DUKE, J.M., 1986. The Dumont nickel deposit: a genetic model for disseminated magmatic sulphide deposits of Komatiite affinity. (Eds: M J Gallacher, R A Ixer, C R Neary and H M Pritchard), metallogeny of Basic and Ultrabasic Rocks, 151-160 (Institute of Mining and Metallurgy: London).

EADIE, E.T., & STALTARI, G. (Editors) 1987. Downhole Electromagnetic methods Special issue. Exploration Geophysics **18**, 247-351.

EMERSON, D.W, 1969, Laboratory Electrical Resistivity Measurements of Rocks, Proceeding of AUSIMM, **230**, Sydney, Australia.

EMERSON, D.W., 1990. Notes on mass properties of rocks – density, porosity, permeability. Explor. Geophys., **21,** 209-216.
Schlinger, 1985.)

EVANS, B.W., & FROST, B.R., 1975. Chrome-spinel in progressive metamorphism – a preliminary analysis. Geochim. Cosmochim. Acta., **39**, 959-972.

FALLON, G.N., FULLAGAR, P.K. & SHEARD, S.N., 1997. Application of geophysics in metalliferous mines. Australian Journal of Earth Sciences (1997) 44, 391-409.

FLOYD, J.F. & TRENCH, A. 1989. Magnetic susceptibility contrasts in Ordovician greywackes of the Southern Uplands of Scotland. Journal of the Geological Society, London, 146, 77-83.

FRIGNET, B., 1986. Induction logs applied to mineral exploration and development; in Borehole Geophysics for Mining and Geotechnical Applications, ed. P.G. Killeen, Geological Survey of Canada, Paper 85-27, 89-100.

FROST, K.M. & GROVES, D.I., 1989a. Magmatic contacts between immiscible sulphide and Komatiite melts: implications for genesis of Kambalda sulphide ores. Economic Geology **84**, 1697-1704.

GOLE, M.J. & HILL, R.E.T., 1990. The refinement of extrusive models for the genesis of nickel deposits: implications from case studies at Honeymoon Well and the Walter Williams Formation. Minerals and Energy Research Institute of Western Australia Report 68, p. 93.

GOODE,A., 2002. Black Swan Nickel Mine notes (Unpubl)

GRANT, F.S., 1985. Aeromagnetics, geology and ore environments, II. Magnetite and ore environments. Geoexplor., **23**. 335-362.

GROVES, D.I., BARRETT, F.M., BINNS, R.A.,& MCQUEEN, K.G., 1977. Spinel phases associated with metamorphosed volcanic-type iron-nickel sulphide ores from Western Australia. Economic Geology 72, 1224-1244.

GROVES, D.I., HUDSON, D.R., HACK, T.B.C., 1974. Modification of iron-nickel sulphides during serpentinisation and talc-carbonate alteration at Black Swan , Western Australia. Economic Geology., 69 1265-1281.

HACK, T.A.C., 1972. Serpentinisation, talc carbonate alteration and nickel mineralisation at Black Swan Kanowna District, Western Australia. University of Western Australia, Bsc (Honours) thesis (unpublished)

HAGGERTY, S.E., 1979. The aeromagnetic mineralogy of igneous rocks. Can, J. Earth Sci, **16**, 1281-1293.

HENKEL, H., 1976. Studies of density and magnetic properties of rocks from northern Sweden. Pure Appl. Geophys., **114**, 235-249.

HICKS, J.D., AND BALFE, G.D., 1998, Silver Swan, Cygnet and Black Swan Nickel Deposits. In: Beckman D.A. and Mckenzie D.H. (eds) Geology of Australia and Papua New Guinea Mineral Deposits. Melbourne, Australian Institute of Mining and Metallurgy, 339-345.

HILL, R.E.T., 1997. Komatiite volcanology and associated nickel sulphide deposits. Exploration and Mining Research News 8, 5-8.

HILL, R.E.T., 1996. Komatiites, Komatiite volcanology, nickel deposits and A visit to extant volcanism, Hawaii, A workshop presented by CSIRO Exploration and Mining.

HILL, R.E.T.,. BARNES S.J., et al. 1995. The volcanology of Komatiites as deduced from field relationships in the Norseman-Wiluna greenstone belt, Western Australia. Lithos **34**, 159-158.

HILL, R.E.T., BARNES,S.J. GOLE, M.J., & DOWLING, S.E., 1990. Physical volcanology of Komatiites, A field guide to the Komatiites of the Norseman- Wiluna Greenstone belt, eastern Goldfields Province, Yilgarn Block, Western Australia.

HILL, R.E.T., BARNES, S.J. & PERRING, C.S., 1996. Komatiite volcanology and the volcanogenic setting of associated magmatic nickel deposits, In. EJ Grimsey & Ian Neuss (eds.), Nickel 96, 99-109. The Australasian Institute of Mining and Metallury.

HILL, R.E.T., BARNES, S.J., THORDARSON, T., DOWLING, S.E. & MATTOX, T.N., 1999. The geology of the Black Swan Succession and associated nickel sulphide orebodies, CSIRO Exploration and Mining Report 646R.

HILL, R.E.T., & Gole, M.J., 1990. Nickel Sulphide deposits of the Yilgarn Block. In Geology of the Mineral Deposits of Australia and Papua New Guinea. F.E. Hughes (Editor.), Australasian Institute of Mining and Metallurgy Monograph 14, 557-559.

HON, K., KAUHIHAUA, J. DENLINGER, R & MACKAY, K., 1994. Emplacement and inflation of pahoehoe sheet flows: observations and measurements of active lava flows on Kilauea Volcano, Hawaii. Geological Society of America Bulletin, **106**, 351-370.

ISLES, D., VALENTA, R., & COOKE, A., 1999. Interpretation and structural analysis of aeromagnetic data, Exploration Geophysics and Remote Sensing and GIS, Codes Short Course Manual 15.

LAPPALEIN, P. & LEHTO, J., 1995. Geophysical borehole logging in ore boundary detection at Outokumpu Mines. In: Proceedings Symposium of 3rd International Symposium on Mine Mechanisation and Automation, Colorado, USA.

LAWRANCE, L.M. 1990. Supergene gold mineralisation, In: Gold Deposits of the Archaean Yilgarn Block, Western Australia: nature, genesis and exploration guides, (eds), Ho, S.E., Groves, D.I., and Bennett, J.M., UWA, Geology Department (Key Centre) and University Extension, Publication 20, 300-313.

LESHER, C.M., 1983. Localisation and genesis of Komatiite-associated Fe-Ni-Cu sulphide mineralisation at Kambalda, Western Australia. Unpub. PhD thesis, UWA, 318pp.

LESHER, C.M., 1989. Komatiite-associated nickel sulphide deposits. In:Whitmey, J.A. & Naldrett, A.J. (eds) Ore Deposition Associated with Magmas. Reviews in Economic Geology 4. El Paso, TX: Economic Geology publishing Company, 44-101.

MARION, J.B., 1976. Physics in the Modern World. Academic Press Inc., New York, p569.

MAYHEW, M.A., WASILEWSKI, P.J., & JOHNSON, B.D., 1991. Crustal magnetisation and temperature at depth beneath the Yilgarn Block, Western Australia inferred from Magsat data. Earth plan. Sci. Let., **107** 515-522.

McCANN, D.M., BARTON, K.J., & HEARN, K., 1981. Geophysical Borehole logging, with special reference to Altnabreac, Caithness. Natural environment research council, Institute of Geological science, Report No. ENPU 81-11.

MCINTYRE, J.I., 1980. Geological significance of magnetic patterns related to magnetite in sediments and metasediments – a review. Bull. Aust. Soc. Explor. Geophys., **11**, 19-33.

MCQUEEN, K.G., 1981ba. Volcanic-associated nickel deposits from around the Widgiemooltha Dome, Western Australia, Economic Geology, 76, 1477-1443.

MEYER, P. and MORRIS, W.A., 1999. The use of borehole geophysics in subsurface mapping: example from the McConnell Nickel Deposit, Sudbury, Ontario, in Lowe, C., Thomas, M.D. and Morris, W.A., eds., Geophysics in Mineral exploration: Fundamentals and Case Histories: Geological Association of Canada, Short Course Notes, v. 14, p. 1-19.

MUELLER, E., MORRIS, W., Killeen, P. and Balch, S., 1997. Combined 3-D interpretation of airborne, surface and borehole vector magnetics at the McConnell nickel deposit, Proceedings of Exploration 97: Fourth Decennial International Conference on Mineral Exploration, GEO F/X, 1068.

MUTTON, A.J., 1994. Application of downhole geophysical logging to lithological correlation and resource assessment in base metal deposits. In: AMIRA Symposium on the Application of Borehole Logging to Mineral Exploration and Mining, Perth, W.A., February 1994. AMIRA.

OGILVY, R.D., 1985. Downhole IP/Resistivity prospecting in mineral drillholes – some illustrative field examples. Geoexploration, **23**: 257-273.

ROBSON, D.F., 1991. Application of magnetics to gold exploration along the victory Defiance trend, Kambalda, W.A. In: J.Hanneson (ed) "Geophysical Case Histories 1989/90" WMC K-Report 3310.

SCHLINGER, C.M., 1985. Magnetisation of lower crust and interpretation of regional magnetic anomalies. J Geophys. Res., **90**, 11484-11504.

SCHON, J.H., 1996. Physical properties of rocks: Fundamentals and principles of petrophysics. Handbook of geophysical exploration; seismic exploration., Volume **18**, 77-116.

SECOR, G., 1974. Kathleen East- ground magnetic survey. Anaconda Company report, (Unpubl.).

SELF, S., FINNEMORE, S., THORDARSON, T & WALKER, G.P.L., 1991. Importance of compound lava and lava-rise mechanisms in emplacement flood basalts. Eos 72, 556-567 (American Geophysical Union Transactions).

SWAGER C.P., WITT, W.K., GRIFFIN, T.J., AHMAT, A.L., HUNTER, W.M., MCGOLDRICK, P.J. and WYCHE,S., 1992. Late Archaean Granite-Greenstones of the Kalgoorlie Terrane, Yilgarn Craton, Western Australia. In: Glover J.E. and Ho S.E. (eds) The Archaean: Terrains, Processes and Metallogeny. Geology Key Centre and University Extension, University of Western Australia.

SUMNER, J., 1979. The induced polarisation method. In: Geophysics and geochemistry in the search for metallic ores, Geological Survey of Canada, Economic geology, report 31. 121-133.

SWAGER C.P., GRIFFIN, T.J., WITT, W.K., WYCHE, S., AHMAT, A.L., HUNTER, W.M. and MCGOLDRICK, P.J., 1995. Geology of the Archaean Kalgoorlie Terrane- An Explanatory Note. Geological Survey of Western Australia, Report 48, 26p.

SWAGER, C.P., 1997. Tectono-stratigraphy of Late Archaean Greenstone Terranes in the Southern Eastern Goldfields, Western Australia. Precambrian Research vol. 83, 11-42.

TELFORD, W.M., GELDART, L. P., & SHERIFF, R.E., 1990. Applied Geophysics. Second Edition. Cambridge University Press, UK.

TRENCH, A., & WILLIAMS, P.K., 1994. Application of geophysics to nickel sulphide exploration in the Kambalda District, Western Australia. In Geophysical Signatures of Western Australian Mineral Deposits, Geology And Geophysics Department (Key Centre) & UWA Extension, The University of Western Australia, Publication No.**26**, 169-179.

TURNBULL, C.W., 1997. Stratigraphy of the Black Swan Nickel Mine, Kalgoorlie, Western Australia. Monash University, BSc (Honours) thesis (Unpubl.).

TULLY, T.M.,1994, Downhole Geophysics at Tara Mines, Navan, Ireland. M.Sc. Thesis. Applied Geophysics Unit, University College, Galway. (Unpublished).

TYNE, E.D., 1987. The development of a computer controlled system for continuous IP logging and spectral IP measurements in Exploration Boreholes. Unpublished PhD thesis, School of Mines, Department of Applied Geology, University of New South Wales.

VIRKKUNEN, R. & HATTULA, A. 1992. Borehole logging at LKAB Malmberget Fe Mine, In Analys I Borrhal, Samnordiskt Projekt, Gruv Teknik 2000, G2000 Report 92:09.

WELLINGTON, A., 1997, Applications of Downhole Electromagnetics in Extensional Exploration in the Nickel Mines of Kambalda. Mining Geology Conference, 161-166.

WILLIAMS, R. & BRAND, N., 1992. The Kambalda Dome Revisited. Proceedings of the WMC Geoscientific Technical Conference, 8th October. 201-217.

Appendix 1

APPENDIX 1

OMS - LOGG

Inductive conductivity, Magnetic susceptibility and gamma-gamma of drill holes BSD 44A, and BSD59 were measured using the OMS-LOGG System. Figure 1 represents a schematic overview of the OMS-LOGG borehole logging system.

Outokumpu Oy in Finland recognised the potential of logging in the base-metal mining context and developed a logging system, OMS-LOGG, specially adapted for underground mining in the 1980's (Lappalainen & Lehto 1995). The OMS-LOGG is a proprietary but commercially available system. The most novel feature of the OMS - LOGG system was it's stiffened cable which enabled the probes to be pushed horizontally and upwards-inclined holes. The OMS-LOGG system is portable and relatively simple to operate.

Specifications of the system are documented below.

To date the primary applications of OMS-LOGG have been as follows:

- To determine lithological boundaries by nature of contrasting physical rock qualities. The man probes used in this application are natural gamma, gamma-gamma, magnetic susceptibility and resistivity.
- To define ore zone boundaries in massive, semi-massive and network style sulphide deposits. Probes used in this application include conductivity and gamma-gamma. By combining several probes it may be possible to discriminate specific sulphides.
- To assign Dry Bulk density estimates to ore and waste using gamma-gamma.

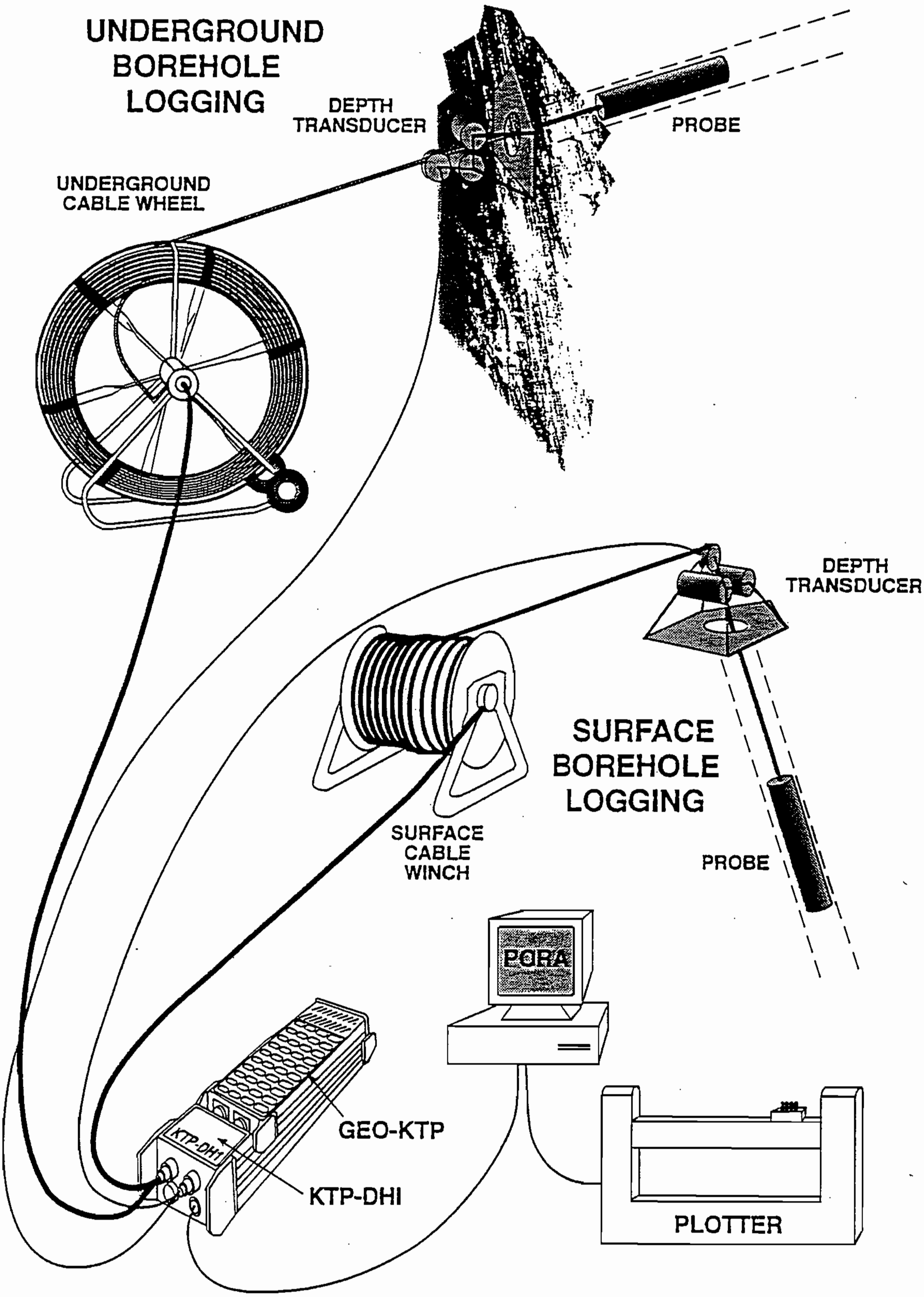


FIGURE 1 : SCHEMATIC OVERVIEW OF THE OMS-LOGG BOREHOLE LOGGING SYSTEM

- To assign ore grades in massive, semi-massive and network style sulphide deposits. To date this function has been successfully implemented for a number of Ni and PB, Zn operations. Probes used for this application are gamma-gamma and conductivity.
- To assign Fe grade in magnetite dominant ore deposits by use of magnetic susceptibility.

At Cosmic Boy mine, Forrestania, Western Australia, where an OMS-LOGG system is used routinely to resolve ore boundaries (Berry 1994). Magnetic susceptibility, gamma-gamma (inversely proportional to density), and conductivity logs are interpreted in parallel to minimise ambiguity in defining the hanging wall contact.

OMS- LOGG System

Hand he ld C omputer K TP-84 a nd D rill H ole Interface K TP-DHI b uild t ogether a portable borehole logging system with digital storage. The system is made up of KTP-84, the Drill Hole Interface KTP-DHI, a borehole probe, the depth transducer and PC software. The system can make use of all analog probes besides impulse output probes and combination probes with more than one value measured. Figure 1 represents a schematic overview of the OMS-LOGG borehole logging system.

RRK-10

Drill Hole Susceptibility Meter

RR K-10 measures the magnetic susceptibility from drill hole based on the one coil system. Due to the short construction of the coil, the variations of susceptibility of very thin layers in the rock can be discerned. The measuring range covers susceptibilities from small values caused by pure magnetite.

RR K-10 probe consists of the measuring coil and electronics. The output RR K-10 is DC voltage, which has been calibrated into susceptibility units in the SI system.

The influence of the rock conductivity upon measuring results is automatically corrected in certain limits. The output voltage can also be calibrated to indicate the content of magnetite in an individual deposit.

RRJ-10 Drill Hole Conductivity Meter

RR J-10 measures inductively the conductivity using one short coil. The equipment has been aimed for logging high conductivities. RR J-10 probe consists of measuring coil and electronics. The response of RR J-10 is increased by susceptibility of the conductor.

Technical Specifications of RR K-10 and RR J-10

Probe dimensions:

Weight	1.1 kg
Length	760mm
Standard diameters	32 mm and 42 mm
Length of measuring coil	100mm

Measuring range of RR K-10:
20×10^{-5} SI to 30 SI units.
Output voltage 0 to +6 V DC

Measuring range of RR J-10:	10 S/m – 10^6 S/m
Output voltage	0 to +9 V DC
Operating frequency:	1200 Hz
Calibration stability:	0.1%/°C
Power consumption:	~2.5W
Supply voltage:	18 V (12.3-30 V)
Working Temperature:	-20°C to +50°C

Maximum working pressure of probe:10Mpa (100bar)

Cable

- 4 cores
- maximum loop resistance 45 ohm (with 18 V supply voltage)

Gamma-Gamma Density Probe OMS-GG10

- Case diameter of 42mm
- Cesium-137 gamma source, 3mCi
- Lead shielding case for gamma source

Appendix 2

LEGEND FOR ULTRAMAFIC ROCKS

$Mr	ribbon textured massive sulfide
$Mt	lattice textured massive sulfide
[$]	disseminated sulfide
$Mfi	felsic plumes in massive sulfide
CrS	skeletal chromite in massive sulfide
UKM	undifferentiated komatite
UOC	undifferentiated olivine cumulate
UKSp	A2 random pyroxene spinifex textured flow
	A3 string-beef pyroxene spinifex textured flow
UpC	pyroxene cumulate
UKSo	A1 flow top breccia olivine spinifex textured flow
	A2 random plates olivine spinifex textured flow
	A3 books olivine spinifex textured flow
UoOC	olivine orthocumulate undifferentiated
UopOC	olivine-pyroxene orthocumulate
UoOCH	olivine orthocumulate harrisitic texture
UoOCb	olivine orthocumulate bimodal texture
UoOCbq	olivine orthocumulate bimodal-quench texture
UoOCP	olivine orthocumulate platey texture
UoOCh	olivine orthocumulate hopper texture
UoOCw	olivine orthocumulate wormy texture
UoOCs	olivine orthocumulate sago texture
UoMC-AC	olivine meso-adcumulate
UoMCs	olivine mesocumulate sago texture
UoMCb	olivine mesocumulate bimodal texture

$Mm	mottled - textured massive sulfide
PF	plume froth
[$c]	disseminated sulfide clasts
	wisps and veinlets of massive sulfide
	magnetite
	breccia
v	vesicles infilled gas + liquid
v$	vesicles infilled with sulfide in a geopetal fabric
AZ	alteration zone
RZ	chloritic reaction zone
MZCON	mixed zone contact
SCON	sharp contact
DCON	diffuse, irregular contact
BCZ	brecciated contact zone
FZ	fault zone
f	fine grained
m	medium grained
c	coarse grained
F	felsic volcanic
	salmon andesite
fi	felsic inclusions
IV	intermediate volcanic
PM	partial melt
HM	hybrid melt
XM	xeno melt
MZ	mixed zone
C	contaminated
QZ	quench zone
	lamprophyre

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Appendix 3

APPENDIX 3	BLACK SWAN GEOPHYSICS FROM CORE				
Hole Number	Depth From (m)	Depth To (m)	Magnetic Susceptibility (SI Units x 10^{-5})	SG	Conductivity (mV)
BSD 019	85	86	no reading	2.74	1000000
	105	106	no reading	2.66	1000000
	115	116	30	2.83	10000000
	116	116	25	2.87	4000000
	120	121	150	2.90	400000
	125	126	100	2.99	6000000
	131	132	30	2.81	3500000
	135	136	30	2.78	2000000
	140	141	65	2.95	2000000
	145	146	40	2.20	350000
	150	151	55	2.96	2000000
	160	161	150	2.95	1000000
	170	171	50	2.92	2000000
	180	181	30	2.89	130000
	183	184	10	2.91	1000
	185	186	5	2.67	4000000
	190	191	15	2.88	400000
	195	196	20	2.88	3000000
	200	201	15	2.88	150000
	205	206	150	2.86	40000
	210	211	200	2.91	2000000
	215	216	20	2.89	2000000
	220	221	1000	2.93	1000000
	225	226	3500	2.88	2000000
	230	231	400	2.89	2000000
	235	236	30	2.95	3000000
	240	241	20	2.98	1000000
	245	246	40	2.94	10000000
	250	251	90	2.94	800000
	255	256	no reading	2.95	60000
	260	261	no reading	2.68	2000000
	270	271	150	2.91	10000000
	275	276	200	2.95	1000000
	280	281	10	2.99	8000000
	285	286	50	2.96	100000
	290	291	150	2.95	2000000
	295	296	20	2.97	800000
	300	301	10	2.69	2000000
	305	306	60	2.95	6000000
	364	365	25	2.95	3000000
	366	367	550	2.76	800000
	371	372	25	2.95	2000000
	380	381	10	2.75	1000000
	390	391	no reading	2.79	1000000
	400	400	15	2.82	no reading

	402	403	10	2.87	2000000
	407	408	20	2.92	2000000
	410	411	20	2.91	3000000
	411	412	30	2.89	2000000
	420	421	20	2.89	6000000
	440	441	0	2.79	2000000
BSD26	95	96.00	10	2.70	100000
	100	101	10	2.72	15000
	120	121	10	2.85	60000
	134.8	135.8	55	2.83	4000
	140	141	15	2.74	2000
	145	146	75	2.94	8000
	150	151	150	2.96	6000
	155	156	no reading	2.93	3000
	160	161	50	2.97	10000
	165	166	150	2.97	3000
	170	171	45	2.96	100000
	175	176	300	2.96	10000
	180	181	100	2.92	10000
	185	186	40	2.90	2000000
	190	191	250	2.96	200000
	195	196	95	2.95	40000
	200	201	150	2.80	1500
	205	206	10	2.80	7000
	223	224	70	2.82	10000
	225	226	4500	4.45	no reading
	295	296	5000	4.55	no reading
	296	297	150	2.97	no reading
	297.8	298.3	3000	4.61	no reading
	298.3	299.65	75	3.08	no reading
	299.7	300.05	3000	4.02	no reading
	300.1	300.80	3000	3.72	no reading
	300.8	301.45	6000	4.42	no reading
	301.5	303.7	150	2.89	no reading
	303.7	304.35	4000	4.12	no reading
	305.6	306.7	7000	4.60	no reading
	310	311	20	2.80	10000
BSD44	90	91	40	2.78	200000
	100	101	25	2.75	100000
	110	111	20	2.67	30000
	130	131	10	2.71	20000
	138.4	138.9	25	2.79	10000
	140	141	20	2.68	20000
	145.2	145.9	20	2.78	100000
	146	147	10	2.68	2000
	150	151	20	2.40	10000
	155	156	10	2.64	60
	160	161	40	2.51	10000
	165	166	90	2.90	200000
	170	171	180	2.93	6000000
	215	216	200	2.93	6000000

	220	221	300	2.93	1000000
	225	226	150	2.86	400000
	230	231	120	2.94	30000
	235	236	400	2.95	600000
	240	241	250	2.95	1000000
	245	246	65	3.02	500000
	250	251	250	2.96	150000
	255	256	130	2.95	5000000
	260	261	300	2.95	4000000
	265	266	100	2.91	150000
	270	271	200	2.90	400000
	275	276	200	2.95	100000
	280	281	250	2.99	no reading
BSD44A	180	181	35	2.91	1000000.00
	185	186	77	2.94	8000000.00
	206	207	25	2.95	no reading
	208	209	30	2.98	2000000.00
	210	211	45	2.92	no reading
	211	212	65	3.37	4000000.00
	215	216	10	2.94	300000.00
	220	221	60	2.95	600000.00
	225	226	200	2.90	300000.00
	230	231	80	2.97	80000.00
	235	236	200	2.98	200000.00
	240	241	500	2.98	3000000.00
	245	246	10	2.97	200000.00
	250	251	200	2.95	150000.00
	255	256	140	2.96	150000.00
	260	261	30	2.95	2200000.00
	265	266	300	2.95	60000
	270	271	80	2.92	1500000
	275	276	100	2.92	80000
	280	281	130	2.85	80000
	285	286	100	2.90	200000
	290	291	5	2.93	80000
	295	296	30	2.94	4000000
	300	301	8	2.95	1000000
	305	306.00	120	3.01	3000000
	310	311	60	3.77	400000
	315	316	150	3.01	350000
	320	321	70	3.01	1500000
	325	326	100	3.00	300000
	330	331	300	2.99	500000
	335	336	120	2.97	1500000
	340	341	150	3.19	30000
	345	346	95	3.37	0.001
	350	351	100	3.20	100000
	354	355	0	2.94	no reading
	356	357	0	2.86	1000
	360	361	30	2.88	60000
	370	371	8	2.78	40000

BSD 52	100	101	20	3.04	150000
	105	106	80	2.94	300000
	110	111	100	2.90	150000
	115	116	40	2.85	1000000
	120	121	5	2.71	15000
	130	131	20	2.76	400000
	140	141	5	2.70	70000
	145	146	4	2.76	20000
	150	151	30	2.88	100000
	155	156	60	2.90	4000
	160	161	60	2.95	30000
	165	166	40	2.96	100000
	185	186	100	2.92	80000
	190	191	65	2.92	100000
	205	206	40	1.96	150000
	210	211	250	2.95	500000
	215	216	100	2.96	10000
	220	221	300	2.92	200000
	225	226	150	2.92	7000
	230	231	100	2.85	100000
	235	236	150	2.93	60000
	240	241	200	2.96	200000
	245	246	100	2.95	40000
	250	251	100	2.97	200000
	255	256	250	2.86	200000
	265	266	40	2.85	200000
	270	271	100	2.93	2000000
	275	276	1800	2.91	1500000
	280	281	12	2.84	1000000
	285	286	10	2.94	2000000
	290	291	550	3.01	1000000
	295	296	900	2.97	2500000
	300	301	25	3.63	1700000
	305	306	20	2.93	null
	310	311	25	2.91	null
	315	316	2000	4.72	0
	317	318	12500	4.65	0
	320	321	4	2.80	10000
	325	326	30	2.87	1000
	326.3	326.8	6500	3.85	40
	330	331	8	2.81	2000000
	340	341	20	2.87	400000
	350	351	13	2.87	100000
BSD79	90	91	27	2.83	2000000
	95	96	3	2.78	50000
	100	101	35	3.08	1000000
	111	111.5	30	2.81	4000000
	111.5	112	30	2.82	1000000
	112	112.5	25	2.88	400000
	112.5	113	13	2.86	200000
	113	113.5	15	2.81	400000
	113.5	114	27	2.78	400000

	114	114.5	28	2.84	1500000
	114.5	115	18	2.87	3500000
	115	115.5	25	2.93	500000
	115.5	116	23	2.90	1000000
	116	116.5	25	2.95	2000000
	116.5	117	50	2.82	1000000
	117	117.5	15	2.80	1000000
	117.5	118	15	2.76	450000
	118	118.5	30	2.80	200000
	118.5	119	25	2.80	1000000
	119	119.5	60	2.98	800000
	119.5	120	55	2.93	2000000
	120	121	60	2.86	400000
	125	126	48	2.95	1000000
	130	131	60	2.85	3000000
	135	136	20	2.83	1500000
	140	141	250	2.88	60
	145	146	55	2.86	105
	160	161	60	2.91	105
	191	192	15	2.72	250000
BSD81A	290	291	250	2.95	no reading
	295	296	130	2.95	50000
	320	321	40	2.95	1000000
	325	326	200	2.92	200000
	330	331	330	2.95	350000
	335	336	250	2.90	150000
	340	341	320	2.99	600000
	345	346	200	2.94	180000
	350	351	160	2.93	15000
	355	356	500	2.91	600000
	365	366	25	2.71	300000
	375	376	33	2.72	30000
	380	381	25	2.75	4000000
	385	386	25	2.73	1000000
	390	394	15	2.76	1200000
	395	396	25	2.78	400000
	401	401	40	3.14	150000
	410	411	20	2.70	80000
	430	431	8	2.68	40000
	446	447	20	2.76	1500000
	449	450	25	2.87	6000
	454	455	15	2.89	5000000
	460	461	8	2.71	2000000
	480	481	5	2.68	200000
	485	486	20	2.75	40000
	490	491	37	2.95	100000
	495	496	75	2.91	300000
	500	501	110	2.94	60000
	505	506	200	2.92	1000000
	510	511	15	2.90	1000000
	515	516	55	2.94	5000000
	520	521	80	3.02	200000

	525	526	30	3.03	300000
	530	531	35	2.94	3000000
	535	536	80	2.78	15000000
	540	541	50	2.98	5000000
	545	546	200	3.01	10000000
	550	551	30	2.80	7000000
	555	556	200	3.01	600000
	560	561	40	3.06	180000
	565	566	180	2.87	600000
	570	571	15	3.07	60000
	575	576	15	2.95	3000000
	580	581	110	2.93	10000000
	585	586	20	2.78	2000000
	590	591	70	2.93	60000
	595	596	85	2.94	4000000
	600	601	230	2.94	1200000
	605	606	100	2.82	400000
	610	611	50	3.07	200000
	615	616	95	2.99	800000
	620	621	90	2.91	100000
	625	626	150	3.05	40000
	630	631	70	2.96	2000000
	635	636	68	2.94	1500000
	640	641	90	2.96	200000
	645	646	80	2.87	600000
	650	651	310	2.88	2200000
	655	656	230	2.95	3000000
	660	661	140	2.96	5000000
	665	666	380	2.95	400000
	670	671	350	2.93	800000
	675	676	28	2.75	No reading
	680	681	26	2.73	No reading
	685	686	35	2.75	No reading
	690	691	4	2.93	No reading
	695	696	14	2.95	No reading
	700	701	6	2.92	No reading
	703	704	1600	2.72	No reading
	710	711	1300	2.94	No reading
	715	716	27	2.96	No reading
	720	721	15	2.54	No reading
	725	726	34	2.92	No reading
	729	730	15	2.91	No reading
	731	732	14	2.79	No reading
	733	734	18	2.78	No reading
	735	736	24	3.05	No reading
	740	741	80	3.25	No reading
BSD82	100	101	50	2.96	1000000
	105	106	34	2.97	1500000
	110	111	60	2.97	2000000
	115	116	110	2.98	650000
	120	121	90	2.96	35000
	125	126	38	2.99	1000000

	130	131	35	2.89	800000
	135	136	270	2.97	400000
	140	141	48	2.92	80000
	145	146	150	2.98	100000
	150	151	50	2.94	1800000
	155	156	80	2.91	1000000
	160	161	47	2.89	200000
	165	166	126	2.98	35010000
	170	171	140	2.92	250000
	175	176	47	2.89	1200000
	180	181	48	2.98	400000
	185	186	46	2.92	350000
	190	191	30	2.88	1000000
	195	196	150	2.90	800000
	200	201	20	2.87	8000000
	205	206	186	2.92	350000
	210	211	100	2.93	80000
	215	216	2500	2.89	400000
	220	221	2400	2.93	400000
	225	226	2700	2.90	120000
	230	231	4000	2.79	220000
	235	236	3000	2.64	18000
	240	241	5000	2.73	600000
	245	246	3500	2.93	400000
	250	251	4000	2.78	3000000
	255	256	5500	2.72	700000
	260	261	5000	2.69	250000
	265	266	4200	2.69	1800000
	270	271	5000	2.68	390000
	275	276	4000	2.72	900000
	280	281	1500	2.76	80000
	285	286	2800	2.88	100000
	290	291	300	2.92	600000
	295	296	400	2.92	60000
	300	301	450	2.90	2000000
	305	306	200	2.89	2000000
	310	311	320	2.90	40000
BSD 81A	315	316	100	2.88	350000
(continued)	320	321	20	2.79	39000
	325	326	80	2.86	35000
	330	331	20	2.81	3500000
	335	336	16	2.84	150000
	340	341	60	2.92	500000
	345	346	60	2.90	3000000
	350	351	65	2.94	6500000
	355	356	55	2.80	1000000
	360	361	68	2.88	3000000
	365	366	45	2.87	100000
	370	371	80	2.88	120000
	375	376	40	2.92	650000
	380	381	80	2.91	1500000
	385	386	12	2.90	350000
	390	391	40	3.00	120000

	395	396	58	2.89	2200000
	400	401	70	2.87	350000
	405	406	45	2.92	4500000
	410	411	38	2.88	180000
	415	416	70	2.90	3500000
	420	421	40	2.89	400000
	425	426	200	2.93	1000000
	430	431	190	2.91	700000
	435	436	500	2.91	15000000
	440	441	350	2.91	8000000
	445	446	600	2.93	600000
	450	451	800	2.94	no reading
	455	456	2500	3.01	null
	460	461	2250	2.96	null
	465	466	700	2.78	null
	470	471	600	2.91	null
	475	476	250	2.90	null
	480	481	850	2.93	null
	485	486	350	2.92	null
	490	491	230	2.92	null
	495	496	140	2.94	null
	515	516	30	2.92	null
	520	521	750	2.94	null
	525	526	650	2.93	null
	535	536	100	2.91	4000000
	540	541	45	2.92	3500000
	545	546	70	2.92	2500000
	550	551	60	2.91	6000000
	555	556	10	2.92	150000
	560	561	50	2.90	null
	565	566	12	2.88	15000000
	567	568	3	2.76	2000000
	570	571	160	2.93	2000000
	575	576	80	2.93	5000000
	580	581	90	2.92	6000000
	585	586	95	2.93	500000
	590	591	300	2.93	8000000
	595	593	55	2.90	2000000
	740	741	8	2.81	3500000
	745	746	3	2.77	1000000
	755	756	10	2.81	60000000
BSD 88	82	83	40	2.82	2500000
	83	84	30	2.71	30000
	84	85	35	2.81	800000
	85	86.52	35	2.92	400000
	87	88	15	2.67	10000000
	88	89	45	2.85	no reading
	90	90	48	2.85	no reading
	92	91	60	2.96	2000000
	96	97	30	2.90	400000
	97	98	30	2.86	150000

	100	101	50	2.91	60000
	105	106	43	2.84	30000
	110	111	20	2.89	150000
	115	116	15	2.85	12000
	120	121	18	2.75	200000
	125	126	15	2.89	80000
	130	131	20	2.79	4000
	135	136	15	2.97	20000
	140	141	350	2.87	150000
	145	146	390	2.93	100000
	150	151	300	2.84	100000
	155	156	50	2.85	60000
	160	161	280	2.89	20000
	165	166	160	2.91	130000
	170	171	30	2.91	40000
	175	176	180	2.94	200000
	180	181	400	2.91	400000
	185	186	120	2.93	80000
	190	191	200	2.91	60000
	195	196	420	2.91	40000
	200	201	50	2.89	40000
	205	206	20	2.89	1000000
	210	211	47	2.91	500000
	215	216	20	2.94	300000
	220	221	80	2.95	60000
	225	226.0	50	2.90	80000
	230	231	100	2.92	10000
	235	236	75	2.90	150000
	240	241	20	2.88	100000
	245	246	no reading	2.77	1500000
	250	251	45	2.93	200000
	255	256	65	2.92	400000
	260	261	25	2.91	150000
	265	256	35	2.86	40000
	270	271	60	2.23	60000
	275	276	35	2.86	1200000
	280	281	45	2.93	8000
	285	286	65	2.93	30000
	290	191	110	2.98	60000
	295	296	20	2.93	120000
	300	301	50	2.92	80000
	305	306	75	2.89	6000
	310	311	75	2.89	150000
	315	316	250	2.90	3500000
	320	321	7	2.82	100000
	325	326	no reading	2.73	1000000
	330	331	4	2.72	40000
BSD92	70	71	14	2.98	null
	80	81	50	2.95	1800000
	90	91	no reading	2.92	800000
	100	101	20	2.96	430000
	110	111	12	2.91	100000

	120	121	14	2.97	100000
	130	131	15	2.95	60000
	140	141	25	2.93	80000
	150	151	20	2.94	300000
	160	161	20	2.94	600000
	170	171	23	2.95	350000
	180	181	20	2.93	650000
	190	191	80	3.00	30000
	200	201	28	2.91	200000
	210	211	200	2.93	120000
	220	221	30	2.94	500000
	230	231	8	2.90	500000
	240	241	200	2.91	250000
	250	251	280	2.95	12000
	260	261	150	2.94	1500000
	270	271	10	2.76	700000
	290	291	no reading	2.77	75000
	310	311	no reading	2.80	120000
	330	331	10	2.78	400000
	340	341	18	2.80	200000
	350	351	10	2.76	600000
	353	354	15	2.88	22000
	354	355	18	2.88	8000000
	355	356	16	2.71	4000
	360	361	13	2.71	150000
	365	366	13	2.85	400000
	375	376	10	2.86	200000
	380	381	20	2.86	600000
	385	386	18	2.79	40000
	390	391	7	2.87	1000000
	395	396	40	2.90	1500000
	400	401	300	2.91	600000
	405	406	35	2.89	1000000
	410	411	60	2.89	1500000
	420	421	30	2.85	1100000
	425	426	140	2.90	200000
	430	431	110	2.89	35000
	435	436	150	2.89	100000
	440	441	40	2.87	150000
	445	446	100	2.91	2000000
	450	451	80	2.92	800000
	455	456	20	2.85	600000
	460	461	50	2.91	600000
	465	466	90	2.89	800000
	470	471	300	2.94	750000
	475	476	20	2.90	120000
	480	481	50	2.93	110000
	485	486	280	2.92	200000
	490	491	35	2.92	600000
	495	496	28	2.95	1200000
	500	501	55	2.98	60000
	505	506	140	2.96	1000000
	510	511	80	2.96	2000000

	515	516	300	2.94	1000000
	520	521	170	2.96	1100000
	525	526	150	2.88	4000000
	530	531	5	2.93	100000
	535	536	35	2.94	1500000
	537	538	70	2.92	1500000
	539.8	540.3	17	2.92	800000
	540.8	541.2	23	2.92	2000000
	542	543	15	2.87	100000
	544	545	12	2.79	35000
	550	551	60	2.88	600000
	560	561	5	2.81	300000
	570	571	13	2.81	600000
	580	581	12	2.85	1500000
	590	591	10	2.84	600000
BSD112	125	126	2200	2.91	4000000
	135	136	1000	2.84	45000
	145	146	40	2.92	6000000
	155	156	150	2.95	150000
	165	166	125	2.94	3000000
	175	176	60	2.93	2000000
	185	186	50	2.94	400000
	195	196	380	2.94	150000
	205	206	2500	2.95	1500000
	215	216	5000	2.95	1000000
	225	226	8000	2.75	1800000
	235	236	14000	2.73	500000
	245	246	15000	2.83	200000
	255	256	12500	2.61	110000
	265	266	14000	2.70	150000
	275	276	12000	2.74	110000
	285	286	9000	2.73	4000000
	295	296	5500	2.92	4000000
	305	306	7500	2.94	4000000
	315	316	7000	2.95	4000000
	325	326	14000	2.89	400000
	335	336	13000	2.84	2000000
	345	346	11000	2.77	300000
	355	356	5400	2.75	1100000
	365	366	5700	2.82	2000000
	375	376	3000	2.92	6000000
	385	386	6400	2.88	6000000
	395	396	3000	2.94	4000000
	405	406	56	2.93	3000000
	415	416	18	2.94	6000000
	425	426	20	2.83	15000000
	426	426.4	18	2.84	8000000
	426.4	427.7	10	2.82	6000000
	430	431	70	2.92	6000000
	435	436	200	2.91	2200000
	440	441	160	2.95	no reading
	445	446	20	2.91	2000000

	450	451	100	2.95	null
	455	456	170	3.02	4000000
	460	461	150	2.97	6000000
	465	466	250	2.98	10000000
	470	471	8	2.75	10000000
	480	481	18	2.82	4000000
	488.7	489.1	18	2.89	3000000
	490	491	6	2.74	5000000
	500	501	9	2.73	8000000
	510	511	20	2.77	3500000
	520	521	10	2.81	6000000
	530	531	7	2.80	6000000

Appendix 4

APPENDIX 4

GEOPHYSICAL DATA ACQUISITION

Magnetic Susceptibility

The instrument used to measure magnetic susceptibility on diamond core was a Geometrics JH-8 handheld susceptibility meter. It was used on cut and rounded core samples. This is permissible as long as the diameter of the core is not less than the inducting coil inside the magnetic susceptibility meter. If the core is smaller, a correction for the air gap between the coil and the core must be made, however most core diameter is greater.

No correction has been applied to the data to account for possible surface effects the data is therefore strictly apparent susceptibilities.

Specific Gravity

Density measurements have been made on drill core using the displacement-of –water method. Specific gravity was collected as the mass per unit volume of rock was compared to water.

Specific Gravity (g/cc) = $\text{Mass}_{air}/\text{Weight}_{air}\text{-Weight}_{water}$

Densities were determined in this study by laboratory methods. There are two main laboratory methods for determining density, the wet bulk density and the dry bulk density. These methods determine the effect of porosity on the density of rocks, as outlined by Emerson (1990). As the rocks in the study are of igneous and metamorphic origin, the effect of porosity was not considered as an important feature, as the changing mineralogy with metamorphic grade.

Resistivity/Conductivity

The resistivity of a rock is the ability of the minerals within the rock to conduct electricity per unit of length. Hence the units for resistivity are ohm-metres. Because most rocks are not monomineralic we measure the bulk or apparent resistivity. This can be measured in the laboratory using current and potential electrodes connected to the sample.

The “Ominaisvastusmittari 10 MS-4 (Serial Number – 03)” is a Finnish-made resistivity meter that is designed to measure the apparent resistivity for drill core samples. Whole core can be placed in a 'clamp' device that has four copper electrodes, two current electrodes and two potential electrodes. On cut surfaces a special device is used to measure apparent resistivity. This is done using four evenly spaced copper electrodes on a flat surface, once again two are current electrodes and two are potential electrodes.

When a sample is placed in the clamp device the core can be rotated in order to measure the resistivity in any preferred alignment that the mineral grains may have normal to the drilling direction. This not only allows for the most accurate reading but also analysing the anisotropy within samples. For example, magnetite is a very conductive mineral and in banded iron the bands of massive magnetite will conduct much more effectively and the orientation that the sample is measured can greatly affect the apparent resistivity measurement.

For the cut surface measurement the sample cannot be rotated and therefore the preferred orientation cannot be obtained. However, by moving the core along, so different portions of the rock are sampled, a satisfactory measurement can be taken.

The circuitry within the equipment firstly measures the input current at the current electrodes and then the voltage between the two potential electrodes. The distance that these electrodes are apart is constant for each sample and therefore the geometric factor is constant. This allows for the display to read ohm-metres directly.

The limitations of this instrument are that it can accurately measure between 10^6 and 10^{-3} m. This is a wide range and a hence a log scale is used, however not all rocks fit within this range. It has been found that the massive sulphide samples measure well below 10^{-3}m. Measurements that are below this level have been approximated using a multimeter and assume that the output voltage/resistivity relationship is linear.

DOWN HOLE GEOPHYSICAL MEASUREMENTS

OMS - LOGG

Inductive conductivity, Magnetic susceptibility and gamma-gamma of drill holes BSD 44A, and BSD59 were measured using the OMS-LOGG System.

CORRELATION OF GEOPHYSICAL LOGS WITH GEOLOGICAL UNITS

Lab Calibration

Ideally, representative hand samples and core should be described geologically, mineralogically and geomechanically, then submitted for a range or rock-property determinations. Sub-samples from the same specimens should be geochemically assayed to establish relationships between petrophysical properties and elemental abundance. The sample suite must include specimens of both ore and host lithologies.

Lab petrophysical results permit calibration of borehole probes. Two types of calibrations can be defined. The first is the calibration of the raw probe output to a physical property (e.g. relating gamma-gamma logs to density). The second is the calibration of a physical property to another parameter (e.g. relating sonic logs to unconfined compressive strength or conductivity to grade.)

Petrophysical properties measured in situ by a borehole probe can differ from laboratory determinations on the drill core taken from the same location for a number of reasons. Fundamentally, of course, the measurements relate to different material, namely that which was removed from the hole and that which remained around it. Furthermore, the petrophysical value provided by a borehole probe is representative of a far larger volume of rock (~50 cm diameter cylinder, say) than the corresponding core sample (~5 cm diameter). Other factors that cause variance include the insitu rock stress (which mainly affects porosity and sonic velocity), salinity and temperature of interstitial fluid (which affect electrical conductivity), and drill-induced porosity, permeability and magnetisation .It is suggested that at least 30 samples per lithotype are required for accurate petrophysical characterisation.

Appendix 5

Appendix 5A- OMS-LOGG

BSD 44A

Susceptibility			**Gamma-Gamma**		**Conductivity**	
deoth	Susceptibility m	lithocode	depth	Gamma-gamma-CPS	depth	Conductivit
101.42	-1.8		101.73	24733	102.02	-0.7
101.52	1.1		101.83	23855	102.12	-0.6
101.63	1.6		101.93	24900	102.23	-0.5
101.73	2.7		102.03	25629	102.33	-0.5
101.83	3		102.13	25389	102.43	-0.4
101.93	0.2		102.23	25773	102.53	-0.5
102.03	0.1		102.33	25578	102.63	-0.5
102.14	0.1		102.44	26517	102.74	-0.4
102.24	0.1		102.49	26312	102.84	-0.4
102.34	0.1		102.54	26915	102.94	-0.4
102.44	0.2		102.59	27946	103.04	-0.4
102.54	0.1		102.64	28370	103.14	-0.4
102.65	0		102.69	28703	103.25	-0.3
102.75	0		102.74	29693	103.35	-0.4
102.85	0		102.79	29446	103.45	-0.3
102.95	-0.1		102.84	29772	103.55	-0.3
103.05	0		102.89	29299	103.65	-0.3
103.16	0		102.94	30149	103.76	-0.3
103.26	0		102.99	29093	103.86	-0.3
103.36	0		103.05	29505	103.96	-0.3
103.46	0.1		103.1	28983	104.06	-0.3
103.56	0.2		103.15	29154	104.16	-0.2
103.67	0.1		103.2	28829	104.27	-0.2
103.77	0.2		103.25	29748	104.37	-0.3
103.87	0.5		103.3	29583	104.47	-0.3
103.97	0.5		103.35	29803	104.57	-0.2
104.07	0.3		103.4	28994	104.67	-0.2
104.18	0.3		103.45	28262	104.78	-0.3
104.28	0.3		103.5	28456	104.88	-0.2
104.38	0.3		103.55	28211	104.98	-0.2
104.48	0.4		103.6	28150	105.08	-0.2
104.58	0.6		103.65	29000	105.18	-0.3
104.69	0.6		103.71	28780	105.29	-0.2
104.79	0.6		103.76	28725	105.39	-0.2
104.89	0.6		103.81	28328	105.49	-0.2
104.99	0.7		103.86	27903	105.59	-0.2
105.09	0.7		103.91	27819	105.69	-0.1
105.2	0.6		103.96	26966	105.8	-0.1
105.3	0.6		104.01	26349	105.9	-0.2
105.4	0.6		104.06	25559	106	-0.2
105.5	0.6		104.11	25051	106.1	-0.2
105.6	0.5		104.16	24854	106.2	-0.2
105.71	0.6		104.21	25758	106.31	-0.1
105.81	0.6		104.26	26927	106.41	-0.1
105.91	0.3		104.31	27670	106.51	-0.1
106.01	0.2		104.36	27680	106.61	-0.2
106.11	0.3		104.42	27678	106.71	-0.2
106.22	0.3		104.47	28367	106.82	-0.1
106.32	0.5		104.52	28693	106.92	-0.1
106.42	0.5		104.57	28376	107.02	-0.1
106.52	0.4		104.62	28106	107.12	-0.1
106.63	0.4		104.67	27756	107.23	-0.1

106.73	0.3		104.72	26967	107.33	0
106.83	0.3		104.77	27400	107.43	-0.1
106.93	0.3		104.82	26495	107.53	-0.1
107.03	0.3		104.87	26413	107.63	-0.1
107.14	0.4		104.92	26564	107.74	-0.1
107.24	0.3		104.97	26463	107.84	-0.1
107.34	0.3		105.02	27426	107.94	-0.1
107.44	0.3		105.08	28177	108.04	0
107.54	0.3		105.13	29532	108.14	0
107.65	0.2		105.18	29834	108.25	0
107.75	0.6		105.23	30534	108.35	0.1
107.85	2.2		105.28	30534	108.45	0
107.95	1.3		105.33	30122	108.55	0
108.05	0.2	11	105.38	29169	108.65	0
108.16	0.2	11	105.43	28941	108.76	0
108.26	0.1	11	105.48	28292	108.86	0
108.36	0.3	11	105.53	27952	108.96	0
108.46	0.3	11	105.58	26950	109.06	-0.1
108.56	0.2	11	105.63	26907	109.16	0
108.67	0.2	11	105.68	25216	109.27	0
108.77	0.3	11	105.74	24612	109.37	0
108.87	0.3	11	105.79	24970	109.47	-0.1
108.97	0.4	11	105.84	24688	109.57	0
109.07	0.4	11	105.89	25156	109.67	0
109.18	0.4	11	105.94	25182	109.78	0
109.28	0.3	11	105.99	24724	109.88	-0.1
109.38	0.3	11	106.04	24786	109.98	0
109.48	0.3	11	106.09	24281	110.08	0.1
109.58	0.3	11	106.14	25460	110.18	0
109.69	0.3	11	106.19	24871	110.29	0
109.79	0.2	11	106.24	25100	110.39	0
109.89	0.2	11	106.29	24540	110.49	0
109.99	0.2	11	106.34	23955	110.59	0
110.09	0.2	11	106.4	23948	110.69	0
110.2	0.3	11	106.45	23694	110.8	0.1
110.3	0.2	11	106.5	24081	110.9	0
110.4	0.2	1	106.55	23218	111	0
110.5	0.1	11	106.6	23883	111.1	0
110.6	0.1	11	106.65	23586	111.2	0.1
110.71	0.2	11	106.7	24257	111.31	0
110.81	0.1	11	106.75	23864	111.41	0.1
110.91	0.1	11	106.8	24058	111.51	0.1
111.01	0.2	11	106.85	24018	111.61	0
111.11	0.4	11	106.9	24218	111.71	0
111.22	0.3	11	106.95	24170	111.82	0.1
111.32	0.2	11	107	24275	111.92	0.1
111.42	0.1	11	107.06	24776	112.02	0
111.52	0.1	11	107.11	25288	112.12	-0.1
111.62	0.1	11	107.16	25447	112.22	-0.1
111.72	0.2	11	107.21	25697	112.32	-0.1
111.82	0.2	11	107.26	24803	112.42	-0.1
111.92	0.3	11	107.31	24453	112.52	-0.1
112.02	0.4	11	107.36	24141	112.62	-0.1
112.12	0.4	11	107.41	23852	112.72	-0.1
112.22	0.5	11	107.46	24024	112.82	-0.1
112.32	0.3	11	107.51	24426	112.92	-0.1

112.42	0.3	11	107.56	24049	113.02	-0.1
112.52	0.3	11	107.61	24472	113.12	-0.1
112.62	0.3	11	107.66	24628	113.22	-0.2
112.72	0.3	11	107.72	24709	113.32	-0.1
112.82	0.3	11	107.77	25497	113.42	-0.1
112.92	0.3	11	107.82	24786	113.52	-0.1
113.02	0.3	11	107.87	25046	113.62	-0.1
113.12	0.3	11	107.92	24261	113.72	-0.1
113.22	0.3	11	107.97	24828	113.82	-0.1
113.32	0.3	11	108.02	25600	113.92	-0.1
113.42	0.2	11	108.07	25983	114.02	-0.1
113.52	0.3	11	108.12	25468	114.12	0
113.62	0.3	11	108.17	25019	114.22	0
113.72	0.4	11	108.22	25599	114.32	-0.1
113.82	1.7	11	108.27	26131	114.42	0
113.92	3.5	11	108.32	24960	114.52	0
114.02	1.3	11	108.38	25738	114.62	-0.1
114.12	1.1	11	108.43	25828	114.72	-0.1
114.22	0.7	11	108.48	25693	114.82	0
114.32	0.5	11	108.53	25391	114.92	-0.1
114.42	0.5	11	108.58	25727	115.02	0
114.52	0.4	11	108.63	25570	115.12	0
114.62	0.4	11	108.68	25779	115.22	-0.1
114.72	0.5	11	108.73	25637	115.32	-0.1
114.82	0.5	11	108.78	24919	115.42	-0.1
114.92	0.4	11	108.83	24925	115.52	0
115.02	0.3	11	108.88	25248	115.62	0
115.12	0.3	11	108.93	25613	115.72	-0.1
115.22	0.2	11	108.98	25582	115.82	-0.1
115.32	0.3	11	109.04	25599	115.92	0
115.42	0.3	11	109.09	25819	116.02	0
115.52	0.3	11	109.14	25588	116.12	0
115.62	0.3	11	109.19	25834	116.22	0
115.72	0.4	11	109.24	26047	116.32	0
115.82	0.3	11	109.29	26135	116.42	0
115.92	0.3	11	109.34	26080	116.52	0
116.02	0.3	11	109.39	26224	116.62	0
116.12	0.2	11	109.44	25365	116.72	0.1
116.22	0.2	11	109.49	25204	116.82	0.1
116.32	0.2	11	109.54	26125	116.92	0
116.42	0.2	11	109.59	25085	117.02	0
116.52	0.2	11	109.64	25617	117.12	0
116.62	0.2	11	109.69	25584	117.22	0
116.72	0.2	11	109.75	25064	117.32	0
116.82	0.2	11	109.8	25154	117.42	0
116.92	0.2	11	109.85	24664	117.52	-0.1
117.02	0.2	11	109.9	24954	117.62	0
117.12	0.1	11	109.95	25375	117.72	0
117.22	0.1	11	110	24451	117.82	0
117.32	0.2	11	110.05	25266	117.92	-0.1
117.42	0.3	11	110.1	24731	118.02	0
117.52	0.3	11	110.15	24587	118.12	0.1
117.62	0.3	11	110.2	25234	118.22	0
117.72	0.4	11	110.25	24357	118.32	0
117.82	0.4	11	110.3	25131	118.42	-0.1
117.92	0.6	11	110.35	26258	118.52	0

118.02	0.6	11	110.41	26916	118.62	0
118.12	0.5	11	110.46	27010	118.72	0
118.22	0.4	11	110.51	28107	118.82	0
118.32	0.4	11	110.56	27064	118.92	0
118.42	0.3	11	110.61	27015	119.02	-0.1
118.52	0.3	11	110.66	25629	119.12	0
118.62	0.3	11	110.71	25908	119.22	-0.1
118.72	0.3	11	110.76	25949	119.32	0.1
118.82	0.2	11	110.81	25344	119.42	-0.1
118.92	0.3	11	110.86	26173	119.52	0
119.02	0.3	11	110.91	25435	119.62	0
119.12	0.2	11	110.96	25680	119.72	0
119.22	0.2	11	111.01	25888	119.82	0.1
119.32	0.3	11	111.07	25179	119.92	0
119.42	0.3	11	111.12	24345	120.02	0
119.52	0.3	11	111.17	24541	120.12	0
119.62	0.3	11	111.22	24402	120.22	0
119.72	0.3	11	111.27	24986	120.32	-0.1
119.82	0.3	11	111.32	25911	120.42	0
119.92	0.6	11	111.37	25328	120.52	0
120.02	0.7	11	111.42	25193	120.62	0.1
120.12	0.8	11	111.47	25309	120.72	0.1
120.22	0.5	11	111.52	25614	120.82	0
120.32	0.4	11	111.57	25552	120.92	0
120.42	0.3	11	111.62	25484	121.02	0
120.52	0.3	11	111.67	25535	121.12	0
120.62	0.3	11	111.73	25478	121.22	0
120.72	0.3	11	111.78	25861	121.32	0.1
120.82	0.2	11	111.83	25485	121.42	0
120.92	0.2	11	111.88	25700	121.52	0
121.02	0.2	11	111.93	26133	121.62	0
121.12	0.3	11	111.98	25806	121.72	0.1
121.22	0.5	11	112.03	26069	121.82	0.1
121.32	0.5	11	112.08	25971	121.92	0
121.42	0.5	11	112.13	26366	122.02	0
121.52	0.4	11	112.18	26011	122.12	0
121.62	0.5	11	112.23	26247	122.22	-0.1
121.72	0.5	11	112.28	25626	122.32	-0.1
121.82	0.4	11	112.33	25395	122.42	-0.1
121.93	0.4	11	112.38	25959	122.53	0
122.03	0.3	11	112.43	25497	122.63	-0.1
122.13	0.3	11	112.48	25297	122.73	-0.1
122.23	0.3	11	112.53	25854	122.83	0
122.33	0.2	11	112.58	25817	122.93	0
122.43	0.2	11	112.63	25658	123.03	0.1
122.53	0.5	11	112.68	25863	123.13	0.1
122.63	1.2	11	112.73	25680	123.23	0
122.73	0.6	11	112.78	25835	123.33	0.1
122.83	0.6	11	112.83	25676	123.43	0.1
122.94	0.5	11	112.88	25698	123.54	0.1
123.04	0.5	11	112.93	25410	123.64	0.1
123.14	0.5	11	112.98	25939	123.74	0.1
123.24	0.4	11	113.03	25259	123.84	0.1
123.34	0.4	11	113.08	25765	123.94	0
123.44	0.3	11	113.13	24441	124.04	0
123.54	0.3	11	113.18	23908	124.14	0.1

123.64	0.3	11	113.23	24561	124.24	0.1
123.74	0.2	11	113.28	24673	124.34	0.2
123.84	0.2	11	113.33	24541	124.44	0.1
123.95	0.1	11	113.38	25009	124.55	0.1
124.05	0.2	11	113.43	23963	124.65	0.1
124.15	0.2	11	113.48	24550	124.75	0.1
124.25	0.2	11	113.53	24808	124.85	0.1
124.35	0.2	11	113.58	25232	124.95	0.1
124.45	0.2	11	113.63	24706	125.05	0.1
124.55	0.2	11	113.68	24672	125.15	0.2
124.65	0.1	11	113.74	24484	125.25	0.1
124.75	0.2	11	113.79	24209	125.35	0.1
124.85	0.2	11	113.84	23967	125.45	0
124.96	0.3	11	113.89	24358	125.56	0.2
125.06	0.3	11	113.94	23768	125.66	0.1
125.16	0.3	11	113.99	23473	125.76	0.1
125.26	0.5	11	114.04	23565	125.86	0.1
125.36	0.3	11	114.09	23892	125.96	0.1
125.46	0.3	11	114.14	24921	126.06	0.1
125.56	0.2	11	114.19	24570	126.16	0.2
125.66	0.5	11	114.24	24820	126.26	0.2
125.76	1.9	11	114.29	25478	126.36	0.2
125.86	1.7	11	114.34	25644	126.46	0.2
125.97	1	11	114.39	25929	126.57	0.3
126.07	0.9	11	114.44	25802	126.67	0.2
126.17	0.6	11	114.49	25050	126.77	0.2
126.27	0.5	11	114.54	25454	126.87	0.2
126.37	0.4	11	114.59	25586	126.97	0.2
126.47	0.4	11	114.64	25667	127.07	0.1
126.57	0.3	11	114.69	25840	127.17	0.2
126.67	0.3	11	114.74	25727	127.27	0.2
126.77	0.4	11	114.79	25864	127.37	0.2
126.88	0.4	11	114.84	25309	127.48	0.2
126.98	0.4	11	114.89	24768	127.58	0.2
127.08	0.3	11	114.94	24813	127.68	0.2
127.18	0.3	11	114.99	25779	127.78	0.2
127.28	0.2	11	115.04	25682	127.88	0.2
127.38	0.3	11	115.09	25557	127.98	0.2
127.48	0.3	11	115.14	25680	128.08	0.3
127.58	0.4	11	115.19	25912	128.18	0.3
127.68	0.4	11	115.24	25298	128.28	0.3
127.78	0.4	11	115.29	25448	128.38	0.3
127.89	0.5	11	115.34	24947	128.49	0.1
127.99	0.4	11	115.39	24858	128.59	0.2
128.09	0.3	11	115.44	25362	128.69	0.2
128.19	0.3	11	115.49	25563	128.79	0.3
128.29	0.3	11	115.54	25994	128.89	0.3
128.39	0.3	11	115.59	25980	128.99	0.3
128.49	0.3	11	115.64	25423	129.09	0.2
128.59	0.3	11	115.69	25558	129.19	0.3
128.69	0.4	11	115.75	25934	129.29	0.3
128.79	0.6	11	115.8	25654	129.39	0.3
128.9	0.6	11	115.85	25345	129.5	0.3
129	0.6	11	115.9	25889	129.6	0.3
129.1	0.6	11	115.95	25450	129.7	0.4
129.2	0.5	11	116	24925	129.8	0.4

129.3	0.5	11	116.05	25409	129.9	0.3
129.4	0.4	11	116.1	25750	130	0.2
129.5	0.4	11	116.15	25676	130.1	0.2
129.6	0.4	11	116.2	25400	130.2	0.2
129.7	0.4	11	116.25	25378	130.3	0.2
129.8	0.4	11	116.3	25529	130.4	0.3
129.91	0.4	11	116.35	25163	130.51	0.2
130.01	0.4	11	116.4	25793	130.61	0.2
130.11	0.4	11	116.45	26315	130.71	0.3
130.21	0.4	11	116.5	26175	130.81	0.2
130.31	0.4	11	116.55	25640	130.91	0.3
130.41	0.3	11	116.6	25642	131.01	0.3
130.51	0.3	11	116.65	25595	131.11	0.3
130.61	0.3	11	116.7	26227	131.21	0.3
130.71	0.3	11	116.75	25791	131.31	0.4
130.81	0.2	11	116.8	26250	131.41	0.3
130.92	0.2	11	116.85	26420	131.52	0.3
131.02	0.2	11	116.9	26043	131.62	0.3
131.12	0.2	11	116.95	26580	131.72	0.3
131.22	0.3	11	117	26610	131.82	0.3
131.32	0.3	11	117.05	26423	131.92	0.3
131.42	0.2	11	117.1	27005	132.02	0.2
131.52	0.2	11	117.15	25695	132.12	0.1
131.62	0.2	11	117.2	26084	132.22	0.1
131.72	0.4	11	117.25	25505	132.32	0.1
131.82	0.6	11	117.3	26231	132.42	0.1
131.93	0.7	11	117.35	26036	132.53	0.1
132.03	0.6	11	117.4	24500	132.63	0.1
132.13	0.5	11	117.45	25455	132.73	0.1
132.23	0.4	11	117.5	25537	132.83	0.1
132.33	0.4	11	117.55	25370	132.93	0.2
132.43	0.3	11	117.6	25758	133.03	0
132.53	0.3	11	117.65	26112	133.13	0.1
132.63	0.3	11	117.71	25643	133.23	0.1
132.73	0.3	11	117.76	25152	133.33	0.1
132.83	0.3	11	117.81	25887	133.43	0.1
132.94	0.4	11	117.86	25385	133.54	0.2
133.04	0.4	11	117.91	25497	133.64	0.2
133.14	0.4	11	117.96	25652	133.74	0.2
133.24	0.4	11	118.01	25478	133.84	0.3
133.34	0.4	11	118.06	25461	133.94	0.2
133.44	0.4	11	118.11	25682	134.04	0.1
133.54	0.5	11	118.16	25562	134.14	0.2
133.64	0.5	11	118.21	25617	134.24	0.2
133.74	0.4	11	118.26	25926	134.34	0.2
133.84	0.4	11	118.31	26000	134.44	0.3
133.95	0.4	11	118.36	25937	134.55	0.3
134.05	0.4	11	118.41	26367	134.65	0.4
134.15	0.5	11	118.46	26273	134.75	0.4
134.25	0.6	11	118.51	25684	134.85	0.4
134.35	0.7	11	118.56	25889	134.95	0.4
134.45	0.9	11	118.61	25981	135.05	0.4
134.55	1.2	11	118.66	25738	135.15	0.4
134.65	1.2	11	118.71	25923	135.25	0.4
134.75	1.3	11	118.76	25663	135.35	0.5
134.85	1.3	11	118.81	26018	135.45	0.5

134.96	0.7	11	118.86	25526	135.56	0.4
135.06	0.8	11	118.91	25769	135.66	0.4
135.16	0.7	11	118.96	25658	135.76	0.5
135.26	0.7	11	119.01	26066	135.86	0.4
135.36	0.6	11	119.06	25546	135.96	0.3
135.46	0.5	11	119.11	25673	136.06	0.4
135.56	0.6	11	119.16	25536	136.16	0.5
135.66	0.5	11	119.21	25765	136.26	0.5
135.76	0.6	11	119.26	25652	136.36	0.5
135.86	0.4	11	119.31	26532	136.46	0.5
135.97	0.3	11	119.36	25976	136.57	0.5
136.07	0.4	11	119.41	25739	136.67	0.6
136.17	0.7	11	119.46	26058	136.77	0.7
136.27	0.3	11	119.51	26043	136.87	0.6
136.37	0.5	11	119.56	25716	136.97	0.6
136.47	0.6	11	119.61	26227	137.07	0.6
136.57	0.5	11	119.66	26027	137.17	0.6
136.67	0.4	11	119.72	26289	137.27	0.6
136.77	0.4	11	119.77	26152	137.37	0.6
136.88	0.4	11	119.82	25938	137.48	0.6
136.98	0.4	11	119.87	26558	137.58	0.6
137.08	0.4	11	119.92	26347	137.68	0.6
137.18	0.4	11	119.97	25628	137.78	0.6
137.28	0.3	11	120.02	26097	137.88	0.6
137.38	0.5	11	120.07	26139	137.98	0.6
137.48	0.4	11	120.12	26586	138.08	0.6
137.58	0.3	11	120.17	26559	138.18	0.6
137.68	0.8	11	120.22	25638	138.28	0.7
137.78	2	11	120.27	25213	138.38	0.7
137.89	0.9	11	120.32	25673	138.49	0.6
137.99	0.6	11	120.37	25629	138.59	0.6
138.09	0.5	11	120.42	25132	138.69	0.6
138.19	0.5	11	120.47	26426	138.79	0.6
138.29	0.5	11	120.52	25787	138.89	0.6
138.39	0.5	1	120.57	26402	138.99	0.6
138.49	0.4	1	120.62	26329	139.09	0.6
138.59	0.4	1	120.67	25480	139.19	0.6
138.69	0.4	1	120.72	26359	139.29	0.6
138.79	0.4	1	120.77	26971	139.39	0.5
138.9	0.5	11	120.82	26325	139.5	0.5
139	0.5	11	120.87	25865	139.6	0.6
139.1	0.5	11	120.92	26208	139.7	0.5
139.2	0.5	11	120.97	26168	139.8	0.6
139.3	0.4	11	121.02	26010	139.9	0.6
139.4	0.4	11	121.07	27977	140	0.5
139.5	0.4	11	121.12	27216	140.1	0.6
139.6	0.4	11	121.17	27280	140.2	0.6
139.7	0.5	11	121.22	26262	140.3	0.6
139.8	0.4	11	121.27	26130	140.4	0.6
139.91	0.6	11	121.32	25635	140.51	0.6
140.01	0.5	11	121.37	26263	140.61	0.6
140.11	0.5	11	121.42	25040	140.71	0.6
140.21	0.4	11	121.47	25147	140.81	0.6
140.31	0.4	11	121.52	24903	140.91	0.6
140.41	0.3	11	121.57	25722	141.01	0.6
140.51	0.3	11	121.62	26047	141.11	0.6

140.61	0.3	11	121.67	25381	141.21	0.6
140.71	0.3	11	121.73	25827	141.31	0.6
140.81	0.2	11	121.77	25700	141.41	0.2
140.92	0.2	11	121.82	25886	141.52	0.8
141.02	0.2	11	121.87	25762	141.62	0.7
141.12	0.2	11	121.92	25996	141.72	0.7
141.22	0.2	11	121.97	25475	141.82	0.7
141.32	0.2	11	122.02	26187	141.92	0.6
141.42	0.1	11	122.07	25950	142.02	0.5
141.52	0.1	11	122.12	25963	142.12	0.4
141.62	0.1	11	122.17	25884	142.22	0.4
141.72	0.1	11	122.22	25405	142.32	0.4
141.82	0.1	11	122.27	24813	142.42	0.3
141.93	0.1	11	122.32	25994	142.53	0.4
142.03	0.1	11	122.37	25705	142.63	0.4
142.13	0.1	11	122.41	25722	142.73	0.4
142.23	0.1	11	122.46	26859	142.83	0.4
142.33	0.1	11	122.51	26716	142.93	0.4
142.43	0.1	11	122.56	26095	143.03	-0.4
142.53	0.2	11	122.61	26491	143.13	-0.4
142.63	0.3	11	122.66	26976	143.23	-0.4
142.73	0.3	11	122.71	27811	143.33	-0.4
142.83	0.4	11	122.76	27652	143.43	0.4
142.94	0.3	11	122.81	27176	143.54	0.5
143.04	0.4	11	122.86	27934	143.64	0.4
143.14	0.4	11	122.91	27390	143.74	0.5
143.24	0.5	11	122.96	27412	143.84	0.5
143.34	0.6	11	123.01	26933	143.94	0.5
143.44	0.5	11	123.05	26915	144.04	0.4
143.54	0.4	11	123.1	26480	144.14	0.5
143.64	0.4	11	123.15	26102	144.24	0.5
143.74	0.5	11	123.2	25964	144.34	0.5
143.84	0.4	11	123.25	26283	144.44	0.5
143.95	0.3	11	123.3	26994	144.55	0.5
144.05	0.3	11	123.35	25963	144.65	0.5
144.15	0.3	11	123.4	25917	144.75	0.4
144.25	0.2	11	123.45	26532	144.85	-0.4
144.35	0.2	11	123.5	24930	144.95	-0.3
144.45	0.2	11	123.55	25870	145.05	-0.3
144.55	0.2	11	123.6	25585	145.15	-0.3
144.65	0.3	11	123.65	25879	145.25	-0.4
144.75	0.6	11	123.7	25834	145.35	-0.4
144.85	0.7	1	123.74	26243	145.45	-0.3
144.96	0.6	1	123.79	26086	145.56	-0.4
145.06	0.5	11	123.84	26567	145.66	-0.4
145.16	0.6	11	123.89	26254	145.76	-0.4
145.26	0.7	1	123.94	26625	145.86	-0.3
145.36	0.9	1	123.99	25406	145.96	-0.3
145.46	0.8	1	124.04	27037	146.06	-0.3
145.56	0.7	1	124.09	25730	146.16	-0.3
145.66	0.6	1	124.14	25702	146.26	-0.3
145.76	0.6	1	124.19	25625	146.36	-0.4
145.86	0.6	11	124.24	25448	146.46	-0.3
145.97	0.6	11	124.29	25697	146.57	-0.3
146.07	0.5	11	124.34	25969	146.67	-0.3
146.17	0.5	11	124.38	25968	146.77	-0.3

146.27	0.3	11	124.43	26156	146.87	-0.3
146.37	0.3	11	124.48	26873	146.97	-0.3
146.47	0.2	11	124.53	26210	147.07	-0.3
146.57	0.2	11	124.58	26283	147.17	-0.3
146.67	0.3	11	124.63	26751	147.27	-0.3
146.77	0.4	11	124.68	26760	147.37	-0.3
146.88	0.5	11	124.73	27355	147.48	-0.3
146.98	0.6	11	124.78	27332	147.58	-0.3
147.08	0.7	11	124.83	26859	147.68	-0.3
147.18	0.7	11	124.88	27206	147.78	-0.3
147.28	0.7	11	124.93	26603	147.88	-0.2
147.38	0.8	11	124.98	26541	147.98	-0.3
147.48	0.7	11	125.03	26302	148.08	-0.3
147.58	0.6	11	125.07	26476	148.18	-0.3
147.68	0.6	1	125.12	26338	148.28	-0.3
147.78	0.5	1	125.17	26846	148.38	-0.4
147.89	0.5	1	125.22	26021	148.49	-0.3
147.99	0.5	1	125.27	26281	148.59	-0.3
148.09	0.5	1	125.32	26669	148.69	-0.3
148.19	0.5	1	125.37	26057	148.79	-0.3
148.29	0.6	1	125.42	26685	148.89	-0.3
148.39	1.1	1	125.47	26071	148.99	-0.3
148.49	2	1	125.52	26108	149.09	-0.3
148.59	0.8	1	125.57	26437	149.19	-0.3
148.69	0.5	11	125.62	26572	149.29	-0.3
148.79	0.5	11	125.67	26730	149.39	-0.4
148.9	0.4	1	125.71	26503	149.5	-0.3
149	0.4	1	125.76	25883	149.6	-0.3
149.1	0.4	11	125.81	26052	149.7	-0.3
149.2	0.4	11	125.86	26318	149.8	-0.3
149.3	0.4	11	125.91	26312	149.9	-0.3
149.4	0.4	11	125.96	26768	150	-0.3
149.5	0.3	11	126.01	26383	150.1	-0.3
149.6	0.4	11	126.06	27385	150.2	-0.3
149.7	1	11	126.11	26651	150.3	-0.2
149.8	1.1	11	126.16	26541	150.4	-0.2
149.91	0.8	11	126.21	26896	150.51	-0.1
150.01	0.7	2	126.26	26772	150.61	-0.1
150.11	0.8	2	126.31	26742	150.71	-0.1
150.21	0.8	2	126.36	26008	150.81	-0.1
150.31	0.9	2	126.4	26404	150.91	-0.1
150.41	1	2	126.45	26100	151.01	-0.1
150.51	1.2	2	126.5	25987	151.11	-0.1
150.61	1.2	2	126.55	25758	151.21	-0.1
150.71	1.4	2	126.6	25692	151.31	-0.1
150.81	1.3	2	126.65	25489	151.41	-0.1
150.92	1.1	2	126.7	26297	151.52	-0.2
151.02	1	2	126.75	26301	151.62	-0.2
151.12	0.9	2	126.8	25915	151.72	-0.1
151.22	0.8	2	126.85	25404	151.82	-0.2
151.32	0.7	2	126.9	25079	151.92	-0.2
151.42	0.4	2	126.95	25661	152.02	-0.3
151.52	0.4	2	127	26328	152.12	-0.2
151.62	0.4	2	127.04	26248	152.22	-0.2
151.72	0.4	2	127.09	26616	152.32	-0.2
151.82	0.4	2	127.14	26489	152.42	-0.2

151.93	0.4	2	127.19	26698	152.53	-0.2
152.03	0.3	2	127.24	26721	152.63	-0.2
152.13	0.3	2	127.29	26945	152.73	-0.2
152.23	0.4	2	127.34	26474	152.83	-0.2
152.33	0.3	2	127.39	26469	152.93	-0.2
152.43	0.3	2	127.44	26223	153.03	-0.2
152.53	0.3	2	127.49	26663	153.13	-0.2
152.63	0.3	2	127.54	25663	153.23	-0.2
152.73	0.3	2	127.59	25851	153.33	-0.2
152.83	0.3	2	127.64	25528	153.43	-0.2
152.94	0.3	2	127.69	25460	153.54	-0.2
153.04	0.3	2	127.73	26252	153.64	-0.2
153.14	0.3	2	127.78	26255	153.74	-0.2
153.24	0.4	2	127.83	25492	153.84	-0.2
153.34	0.4	2	127.88	26407	153.94	-0.2
153.44	0.4	2	127.93	26685	154.04	-0.2
153.54	0.4	2	127.98	26104	154.14	-0.2
153.64	0.4	2	128.03	25798	154.24	-0.2
153.74	0.4	2	128.08	25995	154.34	-0.2
153.84	0.3	2	128.13	25565	154.44	-0.2
153.95	0.4	2	128.18	26927	154.55	-0.2
154.05	0.4	2	128.23	26318	154.65	-0.2
154.15	0.4	2	128.28	26305	154.75	-0.2
154.25	0.5	2	128.33	26216	154.85	-0.2
154.35	0.6	2	128.37	26420	154.95	-0.2
154.45	0.6	2	128.42	26129	155.05	-0.1
154.55	0.7	1	128.47	26011	155.15	-0.1
154.65	0.7	1	128.52	26535	155.25	-0.2
154.75	0.7	1	128.57	25956	155.35	-0.2
154.85	0.6	1	128.62	25459	155.45	-0.2
154.96	0.6	1	128.67	26424	155.56	-0.2
155.06	0.5	1	128.72	25039	155.66	-0.2
155.16	0.5	1	128.77	25770	155.76	-0.1
155.26	0.5	1	128.82	25803	155.86	-0.1
155.36	0.5	1	128.87	25554	155.96	-0.2
155.46	0.5	1	128.92	25028	156.06	-0.1
155.56	0.6	1	128.97	25169	156.16	-0.2
155.66	1.3	1	129.02	25736	156.26	-0.2
155.76	1.8	1	129.06	26280	156.36	-0.2
155.86	1	1	129.11	24692	156.46	-0.2
155.97	0.9	1	129.16	25114	156.57	-0.1
156.07	0.7	1	129.21	25276	156.67	-0.2
156.17	0.7	1	129.26	25994	156.77	-0.2
156.27	0.6	1	129.31	25751	156.87	-0.2
156.37	0.6	1	129.36	25736	156.97	-0.2
156.47	0.6	1	129.41	25479	157.07	-0.2
156.57	0.6	1	129.46	25593	157.17	-0.2
156.67	0.8	1	129.51	25554	157.27	-0.2
156.77	0.8	1	129.56	25968	157.37	-0.2
156.88	0.7	1	129.61	26352	157.48	-0.2
156.98	0.5	1	129.66	26464	157.58	-0.2
157.08	0.6	1	129.7	25863	157.68	-0.2
157.18	0.7	1	129.75	25521	157.78	-0.1
157.28	0.8	1	129.8	26398	157.88	-0.2
157.38	0.8	1	129.85	26356	157.98	-0.1
157.48	1	1	129.9	26475	158.08	-0.1

157.58	1.1	1	129.95	26041	158.18	-0.1
157.68	1	1	130	25741	158.28	0
157.78	0.9	1	130.05	25539	158.38	-0.1
157.89	0.9	1	130.1	26333	158.49	-0.1
157.99	0.9	1	130.15	25750	158.59	0
158.09	0.9	1	130.2	25803	158.69	-0.1
158.19	1	1	130.25	26382	158.79	0
158.29	1.2	1	130.3	26203	158.89	-0.1
158.39	1.2	1	130.35	26489	158.99	0
158.49	1.2	1	130.39	26174	159.09	0
158.59	1.4	1	130.44	25903	159.19	0
158.69	1.3	1	130.49	25744	159.29	-0.1
158.79	1.2	1	130.54	26099	159.39	-0.1
158.9	1.1	1	130.59	26724	159.5	0
159	1.2	1	130.64	26378	159.6	-0.1
159.1	0.9	1	130.69	25691	159.7	0
159.2	0.8	1	130.74	27392	159.8	0
159.3	0.7	1	130.79	26698	159.9	-0.1
159.4	0.7	1	130.84	26128	160	0
159.5	0.7	1	130.89	26136	160.1	0.1
159.6	0.6	1	130.94	26158	160.2	0.1
159.7	0.6	1	130.99	26271	160.3	0.1
159.8	0.6	1	131.03	26929	160.4	0.2
159.91	0.5	2	131.08	25846	160.51	0.1
160.01	0.6	2	131.13	25886	160.61	0.1
160.11	0.7	2	131.18	26553	160.71	0.1
160.21	0.6	2	131.23	26159	160.81	0.1
160.31	0.5	2	131.28	25861	160.91	0.1
160.41	0.5	2	131.33	25815	161.01	0.1
160.51	0.7	2	131.38	26535	161.11	0.1
160.61	0.6	2	131.43	26446	161.21	0.1
160.71	0.6	2	131.48	26020	161.31	0
160.81	0.6	2	131.53	26164	161.41	0.1
160.92	0.5	2	131.58	26244	161.52	0.1
161.02	0.5	2	131.63	26769	161.62	0.1
161.12	0.6	2	131.68	25842	161.72	0.1
161.22	0.7	2	131.72	26205	161.82	0.1
161.32	0.5	2	131.78	25678	161.92	0.1
161.42	0.5	2	131.83	26534	162.02	0.1
161.52	0.6	1	131.88	26991	162.12	0
161.62	0.6	1	131.93	26688	162.22	0
161.72	0.8	1	131.98	26264	162.32	0
161.82	0.9	1	132.04	26734	162.42	0
161.92	1.7	1	132.09	27169	162.52	0
162.02	1.8	1	132.14	26102	162.62	0
162.12	1.9	1	132.19	26802	162.72	0
162.22	2.2	1	132.24	26635	162.82	0
162.32	2.9	1	132.29	26544	162.92	0.1
162.42	2.7	1	132.34	25883	163.02	0
162.52	3.2	1	132.4	26000	163.12	-0.1
162.62	2.8	1	132.45	26719	163.22	-0.1
162.72	1.9	1	132.5	26028	163.32	0
162.82	2	1	132.55	26649	163.42	-0.1
162.92	1.5	1	132.6	26330	163.52	-0.1
163.02	1.9	6.5	132.65	26209	163.62	-0.1
163.12	3.9	6.5	132.71	26598	163.72	-0.1

163.22	4.3	6.5	132.76	26423	163.82	-0.1
163.32	4	6.5	132.81	26839	163.92	-0.1
163.42	4.4	6.5	132.86	26019	164.02	-0.1
163.52	4.3	6.5	132.91	26319	164.12	0
163.62	4.3	6.5	132.96	26623	164.22	0
163.72	4.9	6.5	133.01	26834	164.32	0.1
163.82	5.2	6.5	133.07	26651	164.42	0
163.92	3.9	6.5	133.12	26354	164.52	0.1
164.02	3.5	6.5	133.17	25611	164.62	0
164.12	4	6.5	133.22	26176	164.72	0.1
164.22	3.9	6.5	133.27	25708	164.82	0.1
164.32	3.7	6.5	133.32	25847	164.92	0
164.42	3.5	6.5	133.38	25503	165.02	0
164.52	3.2	6.5	133.43	26766	165.12	0
164.62	2.9	6.5	133.48	25904	165.22	0.1
164.72	2.8	6.5	133.53	26331	165.32	0.1
164.82	3.4	6.5	133.58	25832	165.42	0
164.92	3.1	6.5	133.63	25896	165.52	0
165.02	3.2	6.5	133.68	26537	165.62	0.1
165.12	2.9	6.5	133.74	26479	165.72	0.2
165.22	3	6.5	133.79	26049	165.82	0.2
165.32	2.8	6.5	133.84	26514	165.92	0.2
165.42	2.7	6.5	133.89	25936	166.02	0.2
165.52	2.3	6.5	133.94	25940	166.12	0.3
165.62	2.4	6.5	133.99	26021	166.22	0.2
165.72	2.4	6.5	134.05	26648	166.32	0.2
165.82	2.3	6.5	134.1	25875	166.42	0.2
165.92	2.3	6.5	134.15	25954	166.52	0.1
166.02	2	6.5	134.2	25740	166.62	0.3
166.12	1.9	6.5	134.25	25322	166.72	0.2
166.22	1.9	6.5	134.3	25986	166.82	0.2
166.32	1.6	6.5	134.35	25421	166.92	0.1
166.42	1.5	6.5	134.41	25661	167.02	0.1
166.52	1.6	6.5	134.46	25446	167.12	0.2
166.62	1.7	6.5	134.51	25846	167.22	0.1
166.72	1.3	6.5	134.56	25765	167.32	0.1
166.82	1.2	6.5	134.61	26183	167.42	0.2
166.92	1.3	6.5	134.66	26149	167.52	0.2
167.02	1.3	6.5	134.72	26486	167.62	0.1
167.12	1.1	6.5	134.77	25976	167.72	0.1
167.22	1.2	6.5	134.82	26034	167.82	0.1
167.32	1.2	6.5	134.87	25808	167.92	0.1
167.42	1.4	6.5	134.92	26310	168.02	0.1
167.52	1.5	6.5	134.97	26354	168.12	0.1
167.62	1.5	6.5	135.02	25560	168.22	0.1
167.72	1.5	6.5	135.08	25439	168.32	0.2
167.82	1.4	6.5	135.13	25933	168.42	0.2
167.92	1.3	6.5	135.18	25240	168.52	0.2
168.02	1.7	6.5	135.23	26132	168.62	0.2
168.12	1.7	6.5	135.28	25466	168.72	0.2
168.22	1.7	6.5	135.33	25292	168.82	0.3
168.32	1.9	6.5	135.39	25925	168.92	0.2
168.42	1.8	6.5	135.44	25930	169.02	0.2
168.52	2	6.5	135.49	26153	169.12	0.2
168.62	2.4	6.5	135.54	26166	169.22	0.3
168.72	2.2	6.5	135.59	25798	169.32	0.2

168.82	2.3	6.5	135.64	25814	169.42	0.2
168.92	2.2	6.5	135.69	25761	169.52	0.1
169.02	1.9	6.5	135.75	26768	169.62	0.1
169.12	1.8	6.5	135.8	25848	169.72	0.2
169.22	1.8	6.5	135.85	25510	169.82	0.3
169.32	1.7	6.5	135.9	25928	169.92	0.3
169.42	1.6	6.5	135.95	26528	170.02	0.3
169.52	1.5	6.5	136	25640	170.12	0.3
169.62	1.7	6.5	136.06	26164	170.22	0.3
169.72	1.6	6.5	136.11	26383	170.32	0.3
169.82	1.2	6.5	136.16	25502	170.42	0.4
169.92	1.1	6.5	136.21	26100	170.52	0.3
170.02	1.2	6.5	136.26	26334	170.62	0.3
170.12	1.3	6.5	136.31	26475	170.72	0.3
170.22	1.2	6.5	136.36	26773	170.82	0.3
170.32	1.2	6.5	136.42	26417	170.92	0.3
170.42	1.1	6.5	136.47	26303	171.02	0.3
170.52	1.1	6.5	136.52	24993	171.12	0.3
170.62	1.4	6.5	136.57	25979	171.22	0.3
170.72	1.8	6.5	136.62	25980	171.32	0.3
170.82	1.9	6.5	136.67	26600	171.42	0.3
170.92	2	6.5	136.73	25820	171.52	0.4
171.02	2.1	6.5	136.78	26325	171.62	0.3
171.12	2.1	6.5	136.83	26011	171.72	0.3
171.22	2	6.5	136.88	26274	171.82	0.3
171.32	2.1	6.5	136.93	26188	171.92	0.3
171.42	2.2	6.5	136.98	26211	172.02	0
171.52	1.9	6.5	137.04	26683	172.12	-0.3
171.62	1.6	6.5	137.09	26162	172.22	-0.3
171.72	1.8	6.5	137.14	25404	172.32	-0.3
171.82	1.6	6.5	137.19	25880	172.42	-0.3
171.93	1.6	6.5	137.24	26165	172.53	-0.3
172.03	1.6	6.5	137.29	27037	172.63	-0.3
172.13	1.5	6.5	137.34	26062	172.73	-0.3
172.23	1.5	6.5	137.4	26014	172.83	-0.3
172.33	1.5	6.5	137.45	26145	172.93	-0.2
172.43	1.4	6.5	137.5	25839	173.03	-0.2
172.53	1.3	6.5	137.55	26711	173.13	-0.3
172.63	0.9	6.5	137.6	26306	173.23	-0.3
172.73	1.1	6.5	137.65	26443	173.33	-0.2
172.83	1.3	6.5	137.71	26464	173.43	-0.2
172.94	1.2	6.5	137.76	26044	173.54	-0.2
173.04	1.2	6.5	137.81	25679	173.64	-0.3
173.14	1.2	6.5	137.86	26216	173.74	-0.3
173.24	1.1	6.5	137.91	26251	173.84	-0.2
173.34	1.2	6.5	137.96	25772	173.94	-0.2
173.44	1.2	6.5	138.01	25542	174.04	-0.1
173.54	1.4	6.5	138.07	26148	174.14	-0.2
173.64	1.4	6.5	138.12	26659	174.24	-0.2
173.74	1.1	6.5	138.17	26248	174.34	-0.2
173.84	0.9	6.5	138.22	26254	174.44	-0.2
173.95	1.2	6.5	138.27	25739	174.55	-0.3
174.05	1	6.5	138.32	25544	174.65	-0.2
174.15	1.1	6.5	138.38	26213	174.75	-0.2
174.25	0.9	6.5	138.43	26142	174.85	-0.2
174.35	1	6.5	138.48	26194	174.95	-0.2

174.45	1.1	6.5	138.53	26200	175.05	-0.1
174.55	1	6.5	138.58	26134	175.15	-0.1
174.65	1	6.5	138.63	26303	175.25	-0.2
174.75	0.9	6.5	138.68	26423	175.35	-0.2
174.85	0.9	6.5	138.74	26031	175.45	-0.1
174.96	0.7	6.5	138.79	25563	175.56	-0.1
175.06	0.6	6.5	138.84	25960	175.66	-0.1
175.16	0.6	6.5	138.89	25149	175.76	-0.1
175.26	0.4	6.5	138.94	24029	175.86	-0.1
175.36	0.5	6.5	138.99	23920	175.96	-0.1
175.46	0.6	6.5	139.05	23507	176.06	-0.1
175.56	0.7	6.5	139.1	24221	176.16	-0.1
175.66	0.6	6.5	139.15	24414	176.26	-0.1
175.76	0.7	6.5	139.2	23861	176.36	-0.1
175.86	0.7	6.5	139.25	25145	176.46	-0.1
175.97	0.8	6.5	139.3	24848	176.57	-0.1
176.07	0.8	6.5	139.35	24990	176.67	-0.1
176.17	0.8	6.5	139.41	25216	176.77	-0.1
176.27	1	6.5	139.46	25282	176.87	-0.1
176.37	1.1	6.5	139.51	25434	176.97	-0.1
176.47	1	6.5	139.56	25695	177.07	-0.1
176.57	1.1	6.5	139.61	25699	177.17	-0.1
176.67	1.3	6.5	139.66	25922	177.27	-0.1
176.77	1.3	6.5	139.72	26096	177.37	-0.1
176.88	1.2	6.5	139.77	25759	177.48	-0.1
176.98	1.4	6.5	139.82	26430	177.58	-0.1
177.08	1.9	6.5	139.87	26442	177.68	-0.1
177.18	1.9	6.5	139.92	26638	177.78	-0.1
177.28	2	6.5	139.97	26628	177.88	-0.1
177.38	2.3	6.5	140.02	26287	177.98	-0.1
177.48	2.3	6.5	140.08	26318	178.08	-0.1
177.58	2.2	6.5	140.13	26480	178.18	-0.1
177.68	2.4	6.5	140.18	25668	178.28	0
177.78	1.9	6.5	140.23	26382	178.38	-0.1
177.89	1.9	6.5	140.28	26713	178.49	0
177.99	2.4	6.5	140.33	26547	178.59	-0.1
178.09	2.2	6.5	140.39	26659	178.69	-0.1
178.19	2	6.5	140.44	26488	178.79	-0.1
178.29	1.9	6.5	140.49	26837	178.89	-0.1
178.39	1.6	6.5	140.54	26233	178.99	-0.1
178.49	1.7	6.5	140.59	27508	179.09	-0.1
178.59	1.9	6.5	140.64	27067	179.19	0
178.69	1.6	6.5	140.69	26587	179.29	0
178.79	1.4	6.5	140.75	26406	179.39	-0.1
178.9	1.4	6.5	140.8	25900	179.5	0
179	1.3	6.5	140.85	26435	179.6	-0.2
179.1	1.4	6.5	140.9	27004	179.7	-0.1
179.2	1.3	6.5	140.95	26928	179.8	-0.1
179.3	1.1	6.5	141	26603	179.9	-0.1
179.4	1.1	6.5	141.06	26779	180	-0.1
179.5	1.5	6.5	141.11	26302	180.1	-0.2
179.6	1.9	6.5	141.16	26906	180.2	-0.1
179.7	1.1	6.5	141.21	27301	180.3	0
179.8	1	6.5	141.26	26881	180.4	-0.1
179.91	0.9	6.5	141.31	26153	180.51	-0.1
180.01	0.9	6.5	141.36	26294	180.61	0

180.11	0.8	6.5	141.42	26352	180.71	0
180.21	0.8	6.5	141.47	26477	180.81	0.1
180.31	0.8	6.5	141.52	27055	180.91	0.1
180.41	1.2	6.5	141.57	26642	181.01	0.1
180.51	1.3	6.5	141.62	26123	181.11	0.1
180.61	1.2	6.5	141.67	26293	181.21	0.1
180.71	1.2	6.5	141.73	26613	181.31	0.2
180.81	1.3	6.5	141.78	26248	181.41	0.1
180.92	1.2	6.5	141.83	26728	181.52	0.1
181.02	1.2	6.5	141.88	26414	181.62	0
181.12	1.2	6.5	141.93	25977	181.72	0.1
181.22	0.9	6.5	141.98	26217	181.82	0.1
181.32	0.7	6.5	142.03	26151	181.92	0.1
181.42	0.5	6.5	142.08	26770	182.02	0
181.52	0.8	6.5	142.13	26672	182.12	0.1
181.62	1.8	6.5	142.18	26562	182.22	0.1
181.72	1.5	6.5	142.23	26765	182.32	0.1
181.82	1.4	6.5	142.28	27165	182.42	0.1
181.93	1.3	6.5	142.33	26415	182.53	0.1
182.03	1.3	6	142.38	26711	182.63	0.1
182.13	1.4	6	142.43	26486	182.73	0.1
182.23	1.4	6	142.48	26438	182.83	0.1
182.33	1.5	6	142.53	27293	182.93	0
182.43	1.5	6	142.58	27082	183.03	0
182.53	1.9	6	142.63	26572	183.13	0.1
182.63	2	6	142.68	26683	183.23	0
182.73	1.8	6	142.73	26563	183.33	0.1
182.83	1.7	6	142.78	25587	183.43	0
182.94	1.8	6	142.83	26354	183.54	-0.1
183.04	1.8	6	142.88	26004	183.64	0
183.14	1.9	6	142.93	26647	183.74	0
183.24	1.8	6	142.98	27029	183.84	0
183.34	2.3	6	143.03	26494	183.94	0
183.44	2.4	6	143.08	26652	184.04	0
183.54	2.4	6	143.13	26431	184.14	0
183.64	2.2	6	143.18	26766	184.24	0
183.74	2	6	143.23	26336	184.34	-0.1
183.84	1.6	6	143.28	26360	184.44	-0.1
183.95	1.7	6	143.33	26515	184.55	-0.1
184.05	1.8	6	143.38	26309	184.65	-0.1
184.15	2.3	6	143.43	26247	184.75	0
184.25	3.1	6	143.48	25895	184.85	0
184.35	3.8	6	143.53	25647	184.95	0
184.45	3.3	6	143.58	25423	185.05	0.1
184.55	2.4	6	143.63	26174	185.15	0.1
184.65	2.1	6	143.68	26191	185.25	0.1
184.75	2.2	6	143.74	26087	185.35	0.1
184.85	2	6	143.79	26600	185.45	0.2
184.96	1.6	6	143.84	26320	185.56	0.1
185.06	1.2	6	143.89	27215	185.66	0.2
185.16	0.9	6	143.94	26257	185.76	0.2
185.26	0.6	6	143.99	26316	185.86	0.1
185.36	0.4	6	144.04	27069	185.96	0.1
185.46	0.5	6	144.09	26733	186.06	0.1
185.56	0.6	6	144.14	26868	186.16	0.1
185.66	0.9	6	144.19	26451	186.26	0.1

185.76	1.5	6	144.24	26600	186.36	0
185.86	1.6	6	144.29	26802	186.46	0.1
185.97	1.2	6	144.34	26018	186.57	0.1
186.07	1.4	6	144.39	27005	186.67	0.1
186.17	1	6	144.44	26467	186.77	0.2
186.27	1.1	6	144.49	26000	186.87	0.2
186.37	1.2	6	144.54	26735	186.97	0.2
186.47	0.8	6	144.59	26862	187.07	0.2
186.57	1.1	6	144.64	26713	187.17	0.2
186.67	1.2	6	144.69	26123	187.27	0.1
186.77	1.1	6	144.74	26587	187.37	0.1
186.88	1.3	6	144.79	26821	187.48	0.1
186.98	1.4	6	144.84	26735	187.58	0.1
187.08	1.2	13	144.89	27005	187.68	0.1
187.18	0.8	13	144.94	25845	187.78	0.1
187.28	0.5	13	144.99	26017	187.88	0
187.38	0.5	13	145.04	25916	187.98	0
187.48	0.5	13	145.09	26011	188.08	0.1
187.58	0.5	13	145.14	25823	188.18	0.1
187.68	0.6	13	145.19	26528	188.28	0.2
187.78	0.7	13	145.24	26113	188.38	0.2
187.89	0.8	13	145.29	26179	188.49	0.1
187.99	1	13	145.34	25958	188.59	0.2
188.09	1.3	13	145.39	26037	188.69	0.2
188.19	1.7	13	145.44	25258	188.79	0.2
188.29	1.4	13	145.49	24857	188.89	0.2
188.39	1	13	145.54	24994	188.99	0.1
188.49	1.2	13	145.59	25576	189.09	0.2
188.59	1.2	13	145.64	25487	189.19	0.2
188.69	0.9	13	145.69	24502	189.29	0
188.79	0.6	13	145.75	25377	189.39	0.1
188.9	0.6	13	145.8	25782	189.5	0.1
189	0.7	13	145.85	25204	189.6	0.2
189.1	1	13	145.9	24456	189.7	0.2
189.2	1.4	13	145.95	24694	189.8	0.2
189.3	1.3	13	146	24346	189.9	0.2
189.4	1.2	13	146.05	24796	190	0.3
189.5	1	13	146.1	24691	190.1	0.3
189.6	1	13	146.15	24825	190.2	0.2
189.7	0.9	13	146.2	25131	190.3	0.2
189.8	0.9	13	146.25	24807	190.4	0.2
189.91	1.1	13	146.3	25506	190.51	0.3
190.01	1.2	13	146.35	25227	190.61	0.2
190.11	1.4	13	146.4	26530	190.71	0.2
190.21	1.2	13	146.45	26011	190.81	0.3
190.31	1.3	13	146.5	26519	190.91	0.2
190.41	1.6	13	146.55	26728	191.01	0.2
190.51	1.6	13	146.6	26978	191.11	0.2
190.61	1.2	13	146.65	26829	191.21	0.2
190.71	1.2	13	146.7	26480	191.31	0.2
190.81	1.3	13	146.75	26596	191.41	0.1
190.92	1.4	13	146.8	26680	191.52	0.1
191.02	1.3	13	146.85	26849	191.62	0.1
191.12	1.2	13	146.9	27341	191.72	0.1
191.22	1.1	13	146.95	27370	191.82	0.1
191.32	1	13	147	27266	191.92	0.1

191.42	0.9	13	147.05	27480	192.02	0
191.52	0.8	13	147.1	27154	192.12	-0.1
191.62	0.6	13	147.15	27174	192.22	-0.1
191.72	0.7	13	147.2	26865	192.32	0
191.82	1.1	13	147.25	27000	192.42	0
191.92	1.4	13	147.3	27098	192.52	0
192.02	1.8	13	147.35	27112	192.62	0
192.12	1.6	13	147.4	27619	192.72	0
192.22	1.2	13	147.45	27147	192.82	0
192.32	0.9	13	147.5	27620	192.92	0
192.42	1	13	147.55	27497	193.02	0
192.52	1.2	13	147.6	27297	193.12	0
192.62	1.1	13	147.65	27248	193.22	0
192.72	1.2	13	147.71	27135	193.32	0.1
192.82	1.1	13	147.76	27416	193.42	0
192.92	0.9	13	147.81	27222	193.52	0
193.02	1	13	147.86	27148	193.62	0.1
193.12	0.7	13	147.91	27021	193.72	0.1
193.22	0.7	13	147.96	27062	193.82	0.1
193.32	0.6	13	148.01	26376	193.92	0.1
193.42	0.6	13	148.06	26395	194.02	0.1
193.52	0.6	13	148.11	26664	194.12	0.1
193.62	0.7	13	148.16	26088	194.22	0.1
193.72	0.7	13	148.21	26662	194.32	0
193.82	0.9	13	148.26	26470	194.42	0
193.92	1	13	148.31	26814	194.52	0.1
194.02	0.9	13	148.36	26994	194.62	0
194.12	0.9	13	148.41	26872	194.72	0
194.22	0.9	13	148.46	26908	194.82	0.1
194.32	0.8	13	148.51	27406	194.92	0.1
194.42	0.7	13	148.56	29252	195.02	0.1
194.52	0.8	13	148.61	30031	195.12	0.1
194.62	0.7	13	148.66	28073	195.22	0
194.72	0.7	13	148.71	26200	195.32	0
194.82	0.6	13	148.76	25358	195.42	0.1
194.92	0.5	13	148.81	26060	195.52	0
195.02	0.4	13	148.86	26119	195.62	0.1
195.12	0.5	13	148.91	26214	195.72	0.1
195.22	0.5	13	148.96	25456	195.82	0.1
195.32	0.5	13	149.01	26283	195.92	0.1
195.42	0.4	13	149.06	26920	196.02	0
195.52	0.3	13	149.11	26665	196.12	0.1
195.62	0.3	13	149.16	26359	196.22	0
195.72	0.3	13	149.21	26574	196.32	0.1
195.82	0.2	13	149.26	27245	196.42	0
195.92	0.2	13	149.31	27895	196.52	0
196.02	0.2	13	149.36	28198	196.62	0
196.12	0.3	13	149.41	27758	196.72	0
196.22	0.4	13	149.46	27933	196.82	0.1
196.32	0.4	13	149.51	28214	196.92	0.1
196.42	0.4	13	149.56	28909	197.02	0.1
196.52	0.5	13	149.61	28896	197.12	0.1
196.62	0.5	13	149.66	29229	197.22	0.1
196.72	0.4	13	149.72	29277	197.32	0.1
196.82	0.4	13	149.77	29531	197.42	0.1
196.92	0.3	13	149.82	29622	197.52	0.1

197.02	0.2	13	149.87	30235	197.62	0.1
197.12	0.1	13	149.92	30684	197.72	0.1
197.22	0.1	13	149.97	31559	197.82	0.1
197.32	0.1	13	150.02	30839	197.92	0.1
197.42	0.1	13	150.07	31600	198.02	0.1
197.52	0.2	13	150.12	31380	198.12	0.1
197.62	0.1	13	150.17	31185	198.22	0.1
197.72	0.1	13	150.22	30426	198.32	0.1
197.82	0.1	13	150.27	27787	198.42	0.1
197.92	0.1	13	150.32	26872	198.52	0.1
198.02	0.1	13	150.37	26141	198.62	0.1
198.12	0.1	13	150.42	26437	198.72	0.1
198.22	0.2	13	150.47	26823	198.82	0.1
198.32	0.2	13	150.52	26677	198.92	0.2
198.42	0.2	13	150.57	26558	199.02	0.1
198.52	0.2	13	150.62	25584	199.12	0.2
198.62	0.1	13	150.67	27439	199.22	0.1
198.72	0.1	13	150.72	27271	199.32	0.1
198.82	0.1	13	150.77	27094	199.42	0.2
198.92	0	13	150.82	27880	199.52	0.1
199.02	0	13	150.87	27546	199.62	0.1
199.12	0	13	150.92	27912	199.72	0.1
199.22	0	13	150.97	27836	199.82	0
199.32	0	13	151.02	27194	199.92	0
199.42	0	13	151.07	27506	200.02	0
199.52	0	13	151.12	27423	200.12	0
199.62	0	13	151.17	26956	200.22	0
199.72	0	13	151.22	25441	200.32	0
199.82	0	13	151.27	26769	200.42	-0.1
199.92	0	13	151.32	25053	200.52	0
200.02	0.1	13	151.37	25079	200.62	0
200.12	0.2	13	151.42	24879	200.72	0.1
200.22	0.2	13	151.47	24849	200.82	0.1
200.32	0.2	13	151.52	24798	200.92	0.1
200.42	0.2	13	151.57	24520	201.02	0.1
200.52	0.2	13	151.62	24360	201.12	0.2
200.62	0.3	13	151.67	24226	201.22	0.1
200.72	0.2	13	151.73	24275	201.32	0.1
200.82	0.2	13	151.78	24314	201.42	0.2
200.92	0.2	13	151.83	24128	201.52	0.1
201.02	0.1	13	151.88	24889	201.62	0.1
201.12	0.1	13	151.93	24356	201.72	0.1
201.22	0	13	151.98	24132	201.82	0.2
201.32	0	13	152.03	24258	201.92	0.2
201.42	-0.1	13	152.08	24326	202.02	0.2
201.52	-0.1	13	152.13	24206	202.12	0.2
201.62	-0.1	13	152.18	24377	202.22	0.1
201.72	-0.2	13	152.23	24158	202.32	0.2
201.82	-0.1	13	152.28	23989	202.42	0.2
201.92	-0.1	13	152.33	24305	202.52	0.1
202.02	0	13	152.38	24185	202.62	0.1
202.12	0.1	13	152.43	24173	202.72	0.1
202.22	0.2	13	152.48	23586	202.82	0.1
202.32	0.2	13	152.53	24592	202.92	0.1
202.42	0.2	13	152.58	23962	203.02	0.1
202.52	0.1	13	152.63	24035	203.12	0.2

202.62	0	13	152.68	23940	203.22	0.1
202.72	0	13	152.73	23772	203.32	0.1
202.82	0	13	152.78	24233	203.42	0
202.92	0.1	13	152.83	23877	203.52	0.1
203.02	0.2	13	152.88	24409	203.62	0
203.12	0.1	13	152.93	24396	203.72	0.1
203.22	0	13	152.98	24329	203.82	0.1
203.32	0.1	13	153.03	24289	203.92	0.1
203.42	0.1	13	153.08	24287	204.02	0.1
203.52	0.2	13	153.13	24712	204.12	0.1
203.62	0.2	13	153.18	24316	204.22	0.1
203.72	0.1	13	153.23	24088	204.32	0
203.82	0.1	13	153.28	24746	204.42	0
203.92	0	13	153.33	24735	204.52	0
204.02	0.1	13	153.38	24924	204.62	0
204.12	0	13	153.43	24615	204.72	0
204.22	0	13	153.48	23987	204.82	0
204.32	0	13	153.53	24494	204.92	0
204.42	0	13	153.58	24595	205.02	0
204.52	0.1	13	153.63	24129	205.12	0
204.62	0.3	13	153.68	24559	205.22	0
204.72	0.4	13	153.74	24966	205.32	0.1
204.82	0.4	13	153.79	24342	205.42	0.1
204.92	0.4	13	153.84	24300	205.52	0.1
205.02	0.3	13	153.89	24624	205.62	0.2
205.12	0.3	6	153.94	24155	205.72	0.1
205.22	0.3	6	153.99	24429	205.82	0.1
205.32	0.2	6	154.04	24552	205.92	0.1
205.42	0.2	6	154.09	24484	206.02	0
205.52	0.1	6	154.14	24168	206.12	0
205.62	0.1	6	154.19	24566	206.22	0.1
205.72	0.1	6	154.24	24105	206.32	0.1
205.82	0.1	6	154.29	25080	206.42	0.2
205.92	0.1	6	154.34	25135	206.52	0.2
206.02	0.1	6	154.39	24673	206.62	0.1
206.12	0.1	6	154.44	24035	206.72	0.2
206.22	0.1	6	154.49	24618	206.82	0.2
206.32	0.1	6	154.54	24339	206.92	0.2
206.42	0.1	6	154.59	24708	207.02	0.2
206.52	0	6	154.64	24291	207.12	0.1
206.62	0.1	6	154.69	24328	207.22	0.1
206.72	0.1	6	154.74	24977	207.32	0.1
206.82	0.1	6	154.79	24877	207.42	0.1
206.92	0.1	6	154.84	24686	207.52	0.1
207.02	0.2	6	154.89	25232	207.62	0.1
207.12	0.2	6	154.94	24806	207.72	0.1
207.22	0.4	6	154.99	25000	207.82	0.1
207.32	0.5	6	155.04	24938	207.92	0.2
207.42	0.3	6	155.09	24625	208.02	0.1
207.52	0.2	6	155.14	24623	208.12	0.2
207.62	0.2	6	155.19	24587	208.22	0.1
207.72	0.2	6	155.24	24514	208.32	0.1
207.82	0.2	6	155.29	24934	208.42	0.1
207.92	0.2	6	155.34	25226	208.52	0.1
208.02	0.2	6	155.39	25059	208.62	0.1
208.12	0.3	6	155.44	25167	208.72	0.1

208.22	0.3	6	155.49	25482	208.82	0
208.32	0.3	6	155.54	25818	208.92	0.1
208.42	0.2	6	155.59	25882	209.02	0.1
208.52	0.2	6	155.64	26182	209.12	0.1
208.62	0.1	6	155.69	26638	209.22	0
208.72	0.2	6	155.75	27114	209.32	0
208.82	0.2	6	155.8	25809	209.42	0
208.92	0.2	6	155.85	25822	209.52	0
209.02	0.2	6	155.9	24858	209.62	-0.1
209.12	0.3	6	155.95	25213	209.72	0
209.22	0.2	6	156	24722	209.82	0
209.32	0.2	6	156.05	25075	209.92	0
209.42	0.4	6	156.1	25581	210.02	0
209.52	0.3	6	156.15	25350	210.12	0
209.62	0.3	6	156.2	24417	210.22	0
209.72	0.6	6	156.25	24829	210.32	0
209.82	0.6	6	156.3	25634	210.42	0
209.92	0.6	6	156.35	24907	210.52	0
210.02	0.5	6	156.4	26158	210.62	0
210.12	0.6	6	156.45	25484	210.72	0
210.22	1.2	6	156.5	25192	210.82	0.1
210.32	1.1	6	156.55	25690	210.92	0.2
210.42	0.8	6	156.6	25913	211.02	0.2
210.52	0.5	6	156.65	25642	211.12	0.2
210.62	0.3	6	156.7	25592	211.22	0.2
210.72	0.4	6	156.75	24802	211.32	0.2
210.82	0.5	6	156.8	25168	211.42	0.1
210.92	0.6	6	156.85	24977	211.52	0.1
211.02	0.5	6	156.9	24957	211.62	0.1
211.12	0.7	6	156.95	24944	211.72	0.1
211.22	0.8	6	157	25045	211.82	0.1
211.32	0.7	6	157.05	25115	211.92	0.1
211.42	0.7	6	157.1	25347	212.02	0.1
211.52	0.9	6	157.15	25379	212.12	0
211.62	0.9	6	157.2	25315	212.22	0
211.72	0.6	6	157.25	25555	212.32	-0.1
211.82	0.6	6	157.3	25695	212.42	-0.1
211.93	0.6	6	157.35	25146	212.53	-0.1
212.03	0.5	6	157.4	25261	212.63	-0.2
212.13	0.4	6	157.45	25345	212.73	-0.1
212.23	0.4	6	157.5	24950	212.83	-0.1
212.33	0.5	6	157.55	24956	212.93	-0.1
212.43	0.5	6	157.6	24220	213.03	-0.1
212.53	0.5	6	157.65	23341	213.13	-0.1
212.63	0.7	6	157.71	23327	213.23	-0.1
212.73	0.8	6	157.76	22789	213.33	-0.1
212.83	1	6	157.81	23614	213.43	-0.1
212.94	1.4	6	157.86	23153	213.54	-0.1
213.04	1	6	157.91	24178	213.64	-0.1
213.14	0.7	6	157.96	24220	213.74	-0.2
213.24	0.5	6	158.01	25109	213.84	0
213.34	0.4	6	158.06	25071	213.94	0
213.44	0.4	6	158.11	24646	214.04	0
213.54	0.6	6	158.16	24309	214.14	0
213.64	1	6	158.21	24431	214.24	0
213.74	1.1	6	158.26	24918	214.34	0

213.84	1	6	158.31	24888	214.44	0
213.95	1	6	158.36	24664	214.55	0
214.05	0.8	6	158.41	25069	214.65	0
214.15	0.6	6	158.46	25057	214.75	0
214.25	0.5	6	158.51	24166	214.85	0
214.35	0.4	6	158.56	23645	214.95	0
214.45	0.4	6	158.61	24073	215.05	0
214.55	0.5	6	158.66	23974	215.15	0
214.65	0.5	6	158.71	24351	215.25	0
214.75	0.4	6	158.76	23882	215.35	0
214.85	0.4	6	158.81	24696	215.45	0
214.96	0.6	6	158.86	24474	215.56	0
215.06	0.6	6.5	158.91	24355	215.66	0
215.16	0.4	6.5	158.96	24854	215.76	0
215.26	0.5	6.5	159.01	24457	215.86	0
215.36	0.5	6.5	159.06	24198	215.96	0
215.46	0.4	6.5	159.11	24439	216.06	-0.1
215.56	0.4	6.5	159.16	23573	216.16	-0.1
215.66	0.5	6.5	159.21	24121	216.26	-0.1
215.76	0.4	6.5	159.26	24899	216.36	-0.2
215.86	0.2	6.5	159.31	24160	216.46	-0.1
215.97	0.2	6.5	159.36	24434	216.57	-0.2
216.07	0.2	6.5	159.41	25343	216.67	-0.1
216.17	0.5	6.5	159.46	24686	216.77	-0.1
216.27	0.7	6.5	159.51	24772	216.87	-0.1
216.37	1.1	6.5	159.56	25610	216.97	-0.1
216.47	0.9	6.5	159.61	25531	217.07	-0.2
216.57	0.6	6.5	159.66	28103	217.17	-0.2
216.67	0.7	6.5	159.72	29984	217.27	-0.1
216.77	0.7	6.5	159.77	32897	217.37	-0.1
216.88	0.8	6.5	159.82	36159	217.48	-0.1
216.98	1.4	6.5	159.87	37769	217.58	-0.1
217.08	2.1	6.5	159.92	38681	217.68	0
217.18	2.3	6.5	159.97	37994	217.78	-0.1
217.28	1.7	6.5	160.02	37802	217.88	-0.1
217.38	1.7	6.5	160.07	36944	217.98	-0.1
217.48	1.9	6.5	160.12	35852	218.08	-0.1
217.58	1.9	6.5	160.17	32680	218.18	-0.1
217.68	2.2	6.5	160.22	30569	218.28	0
217.78	3.4	6.5	160.27	30000	218.38	-0.1
217.89	2.1	6.5	160.32	29259	218.49	0
217.99	1.9	6.5	160.37	27842	218.59	-0.1
218.09	2.3	6.5	160.42	25992	218.69	-0.1
218.19	2.6	6.5	160.47	25804	218.79	-0.1
218.29	2.4	6.5	160.52	26433	218.89	-0.1
218.39	1.8	6.5	160.57	24819	218.99	-0.1
218.49	1.4	6.5	160.62	26075	219.09	-0.1
218.59	1.4	6.5	160.67	25861	219.19	-0.1
218.69	1.6	6.5	160.72	26688	219.29	-0.1
218.79	1.9	6.5	160.77	25380	219.39	-0.1
218.9	2	6.5	160.82	24683	219.5	-0.1
219	2.3	6.5	160.87	25091	219.6	-0.1
219.1	2.9	6.5	160.92	25231	219.7	-0.1
219.2	2.2	6.5	160.97	25427	219.8	-0.2
219.3	1.5	6.5	161.02	25292	219.9	-0.1
219.4	2.4	6.5	161.07	24864	220	-0.1

219.5	2.9	6.5	161.12	25255	220.1	-0.1
219.6	3.4	6.5	161.17	26178	220.2	-0.1
219.7	2.7	6.5	161.22	24854	220.3	-0.1
219.8	2.8	6.5	161.27	24923	220.4	-0.1
219.91	2.8	6.5	161.32	26285	220.51	-0.1
220.01	2.4	6.5	161.37	26394	220.61	-0.1
220.11	1.6	6.5	161.42	26005	220.71	-0.1
220.21	2.2	6.5	161.47	27105	220.81	-0.1
220.31	2.1	6.5	161.52	26338	220.91	-0.1
220.41	1.2	6.5	161.57	25412	221.01	-0.1
220.51	1.3	6.5	161.62	24103	221.11	-0.1
220.61	1.4	6.5	161.67	24163	221.21	-0.1
220.71	1.4	6.5	161.73	24054	221.31	-0.1
220.81	1.4	6.5	161.78	23801	221.41	-0.1
220.92	1.4	6.5	161.83	23246	221.52	-0.1
221.02	1.7	6.5	161.88	23726	221.62	-0.1
221.12	1.6	6.5	161.93	23738	221.72	-0.1
221.22	1.8	6.5	161.98	23601	221.82	-0.1
221.32	2	6.5	162.03	23463	221.92	-0.1
221.42	2.3	6.5	162.08	23944	222.02	-0.2
221.52	2.5	6.5	162.13	24687	222.12	-0.2
221.62	2.1	6.5	162.18	24282	222.22	-0.1
221.72	1.8	6.5	162.23	24608	222.32	-0.1
221.82	2.3	6.5	162.28	24792	222.42	-0.2
221.92	2.3	6.5	162.33	24847	222.52	-0.2
222.02	3.2	6.5	162.38	25507	222.62	-0.2
222.12	3.9	6.5	162.43	25878	222.72	-0.2
222.22	2.7	6.5	162.48	27218	222.82	-0.2
222.32	3.4	6.5	162.53	27914	222.92	-0.1
222.42	4.4	6.5	162.58	28034	223.02	-0.2
222.52	4.6	6.5	162.63	28069	223.12	-0.1
222.62	4.5	6.5	162.68	28210	223.22	-0.1
222.72	3.7	6.5	162.73	28688	223.32	-0.1
222.82	2.4	6.5	162.78	27209	223.42	-0.2
222.92	2	6.5	162.83	28694	223.52	-0.2
223.02	2.7	6.5	162.88	28568	223.62	-0.2
223.12	3.2	6.5	162.93	28490	223.72	-0.2
223.22	2.5	6.5	162.98	28896	223.82	-0.3
223.32	2.7	6.5	163.03	27877	223.92	-0.3
223.42	4.2	6.5	163.08	26812	224.02	-0.2
223.52	4.9	6.5	163.13	25904	224.12	-0.2
223.62	5.2	6.5	163.18	27027	224.22	-0.1
223.72	5.3	6.5	163.23	27655	224.32	-0.2
223.82	5	6.5	163.28	26877	224.42	-0.1
223.92	4.1	6.5	163.33	27894	224.52	-0.1
224.02	3.1	6.5	163.38	29028	224.62	-0.1
224.12	2.3	6.5	163.43	31520	224.72	-0.1
224.22	1.8	6.5	163.48	31281	224.82	-0.1
224.32	1.8	6.5	163.53	30315	224.92	-0.1
224.42	2.3	6.5	163.58	28014	225.02	-0.1
224.52	3.3	6.5	163.63	27316	225.12	-0.1
224.62	3.1	6.5	163.68	26444	225.22	-0.1
224.72	3.8	6.5	163.74	25133	225.32	-0.1
224.82	4	6.5	163.79	24559	225.42	-0.1
224.92	2.7	6.5	163.84	24610	225.52	-0.2
225.02	2.4	6.5	163.89	24220	225.62	-0.1

225.12	2.5	6.5	163.94	23896	225.72	-0.1
225.22	2.5	6.5	163.99	24071	225.82	-0.2
225.32	2.8	6.5	164.04	24067	225.92	-0.2
225.42	3.1	6.5	164.09	23411	226.02	-0.3
225.52	3.2	6.5	164.14	23777	226.12	-0.2
225.62	2.4	6.5	164.19	23505	226.22	-0.1
225.72	2.7	6.5	164.24	24004	226.32	-0.1
225.82	2.7	6.5	164.29	23544	226.42	-0.1
225.92	3.1	6.5	164.34	24069	226.52	0
226.02	3.5	6.5	164.39	23759	226.62	-0.1
226.12	3.3	6.5	164.44	24198	226.72	-0.1
226.22	3.3	6.5	164.49	24278	226.82	-0.1
226.32	2.6	6.5	164.54	24367	226.92	-0.1
226.42	2.3	6.5	164.59	23502	227.02	-0.1
226.52	2.3	6.5	164.64	23238	227.12	-0.1
226.62	3.2	6.5	164.69	24043	227.22	-0.1
226.72	3.1	6.5	164.74	23608	227.32	-0.1
226.82	2.7	6.5	164.79	24319	227.42	-0.1
226.92	3.1	6.5	164.84	24549	227.52	-0.1
227.02	3.3	6.5	164.89	24303	227.62	-0.2
227.12	3.2	6.5	164.94	23820	227.72	-0.1
227.22	3.1	6.5	164.99	23737	227.82	-0.1
227.32	2.8	6.5	165.04	23418	227.92	-0.2
227.42	2.9	6.5	165.09	23817	228.02	-0.1
227.52	2.7	6.5	165.14	23750	228.12	-0.1
227.62	3.1	6.5	165.19	23761	228.22	-0.2
227.72	3.3	6.5	165.24	23664	228.32	-0.2
227.82	3.6	6.5	165.29	24197	228.42	-0.1
227.92	3.4	6.5	165.34	23491	228.52	-0.1
228.02	3.3	6.5	165.39	23042	228.62	-0.2
228.12	3.2	6.5	165.44	23355	228.72	-0.2
228.22	2.4	6.5	165.49	23471	228.82	-0.2
228.32	1.7	6.5	165.54	23857	228.92	-0.2
228.42	1.9	6.5	165.59	24333	229.02	-0.1
228.52	1.8	6.5	165.64	23478	229.12	-0.2
228.62	2.5	6.5	165.69	24338	229.22	-0.2
228.72	2.3	6.5	165.75	24195	229.32	-0.2
228.82	1.7	6.5	165.8	23875	229.42	-0.1
228.92	1.3	6.5	165.85	23983	229.52	-0.1
229.02	1.4	6.5	165.9	24340	229.62	0
229.12	0.6	6.5	165.95	23447	229.72	-0.1
229.22	0.7	6.5	166	24274	229.82	-0.1
229.32	0.7	6.5	166.05	23500	229.92	0
229.42	1.2	6.5	166.1	24391	230.02	-0.1
229.52	2.3	6.5	166.15	23811	230.12	-0.1
229.62	2.6	6.5	166.2	23894	230.22	0
229.72	2.2	6.5	166.25	24093	230.32	0
229.82	2.1	6.5	166.3	24171	230.42	0
229.92	1.7	6.5	166.35	23976	230.52	0
230.02	2.1	6.5	166.4	24378	230.62	0
230.12	2.3	6.5	166.45	23856	230.72	0
230.22	2	6.5	166.5	23090	230.82	0
230.32	1.8	6.5	166.55	23639	230.92	0
230.42	1.8	6.5	166.6	23985	231.02	0
230.52	2.9	6.5	166.65	23521	231.12	0
230.62	1.9	6.5	166.7	23901	231.22	0

230.72	1.2	6.5	166.75	24050	231.32	-0.1
230.82	2	6.5	166.8	24004	231.42	0
230.92	2	6.5	166.85	23728	231.52	0
231.02	2.2	6.5	166.9	23575	231.62	0
231.12	2.2	6.5	166.95	23719	231.72	-0.1
231.22	1.5	6.5	167	24102	231.82	-0.1
231.32	2.3	6.5	167.05	23803	231.92	-0.1
231.42	1.9	6.5	167.1	24241	232.02	-0.2
231.52	2	6.5	167.15	24170	232.12	-0.2
231.62	2.2	6.5	167.2	24435	232.22	-0.3
231.72	2.3	6.5	167.25	24861	232.32	-0.2
231.82	2.3	6.5	167.3	23919	232.42	-0.1
231.92	2.8	6.5	167.35	24474	232.52	-0.3
232.02	3	6.5	167.4	24515	232.62	-0.2
232.12	3	6.5	167.45	24064	232.72	-0.3
232.22	3.2	6.5	167.5	23653	232.82	-0.2
232.32	3.1	6.5	167.55	24281	232.92	-0.2
232.42	3.1	6.5	167.6	23717	233.02	-0.1
232.52	3.3	6.5	167.65	24542	233.12	-0.2
232.62	3.2	6.5	167.71	23913	233.22	-0.1
232.72	3.2	6.5	167.76	23400	233.32	-0.1
232.82	2.7	6.5	167.81	23701	233.42	-0.2
232.92	2	6.5	167.86	24056	233.52	-0.1
233.02	1.1	6.5	167.91	23463	233.62	-0.2
233.12	1.4	6.5	167.96	24125	233.72	-0.1
233.22	1.4	6.5	168.01	24612	233.82	-0.2
233.32	1.7	6.5	168.06	23671	233.92	-0.2
233.42	1.4	6.5	168.11	24329	234.02	-0.2
233.52	1.8	6.5	168.16	24142	234.12	-0.2
233.62	2.2	6.5	168.21	24214	234.22	-0.2
233.72	2.6	6.5	168.26	23880	234.32	-0.1
233.82	2.7	6.5	168.31	23773	234.42	-0.2
233.92	2.7	6.5	168.36	24363	234.52	-0.2
234.02	2.2	6.5	168.41	24059	234.62	-0.2
234.12	2.2	6.5	168.46	23946	234.72	-0.3
234.22	2.1	6.5	168.51	23632	234.82	-0.2
234.32	2.3	6.5	168.56	25204	234.92	-0.1
234.42	2.8	6.5	168.61	24608	235.02	-0.1
234.52	2.3	6.5	168.66	24371	235.12	-0.2
234.62	2.9	6.5	168.71	24482	235.22	-0.1
234.72	3.5	6.5	168.76	24500	235.32	0
234.82	3	6.5	168.81	24212	235.42	-0.1
234.92	3.4	6.5	168.86	24258	235.52	-0.1
235.02	3.8	6.5	168.91	24675	235.62	-0.1
235.12	3.3	6.5	168.96	24631	235.72	-0.1
235.22	2.8	6.5	169.01	23893	235.82	-0.1
235.32	3	6.5	169.06	24121	235.92	-0.1
235.42	3.3	6.5	169.11	23893	236.02	-0.1
235.52	2.9	6.5	169.16	24565	236.12	-0.1
235.62	2.3	6.5	169.21	24072	236.22	-0.2
235.72	1.6	6.5	169.26	24762	236.32	-0.1
235.82	1.9	6.5	169.31	24048	236.42	-0.1
235.92	2.6	6.5	169.36	23900	236.52	-0.1
236.02	3	6.5	169.41	23988	236.62	-0.1
236.12	3.2	6.5	169.46	24577	236.72	-0.2
236.22	2.6	6.5	169.51	24543	236.82	-0.1

236.32	1.6	6.5	169.56	23717	236.92	-0.1
236.42	1.7	6.5	169.61	24202	237.02	-0.2
236.52	3.1	6.5	169.66	24161	237.12	-0.2
236.62	3	6.5	169.72	24265	237.22	-0.1
236.72	2.5	6.5	169.77	24681	237.32	-0.1
236.82	2.4	6.5	169.82	24203	237.42	-0.2
236.92	2	6.5	169.87	24065	237.52	0
237.02	2.1	6.5	169.92	23940	237.62	-0.1
237.12	2.2	6.5	169.97	23968	237.72	-0.1
237.22	1.7	6.5	170.02	23865	237.82	0
237.32	1.8	6.5	170.07	23528	237.92	-0.1
237.42	2.2	6.5	170.12	24527	238.02	0
237.52	2.2	6.5	170.17	24073	238.12	0
237.62	1.3	6.5	170.22	24072	238.22	-0.1
237.72	1.9	6.5	170.27	23825	238.32	-0.1
237.82	2.6	6.5	170.32	23619	238.42	0
237.92	2.3	6.5	170.37	24565	238.52	0
238.02	1.3	6.5	170.42	24047	238.62	-0.1
238.12	1.4	6.5	170.47	24549	238.72	0
238.22	1.8	6.5	170.52	24059	238.82	-0.1
238.32	1.7	6.5	170.57	23749	238.92	-0.1
238.42	1.4	6.5	170.62	23725	239.02	-0.2
238.52	1.1	6.5	170.67	24347	239.12	-0.2
238.62	1.3	6.5	170.72	24009	239.22	-0.1
238.72	1.6	6.5	170.77	23500	239.32	-0.1
238.82	2.7	6.5	170.82	24255	239.42	-0.1
238.92	4.4	6.5	170.87	24139	239.52	-0.1
239.02	4.2	6.5	170.92	23353	239.62	-0.1
239.12	3.7	6.5	170.97	24515	239.72	-0.1
239.22	2.9	6.5	171.02	24824	239.82	-0.1
239.32	3.4	6.5	171.07	24513	239.92	-0.2
239.42	3.5	6.5	171.12	23737	240.02	-0.1
239.52	3.2	6.5	171.17	23650	240.12	-0.1
239.62	2.6	6.5	171.22	23524	240.22	-0.2
239.72	2.9	6.5	171.27	24235	240.32	-0.2
239.82	2.5	6.5	171.32	23648	240.42	-0.2
239.92	2.9	6.5	171.37	24201	240.52	-0.1
240.02	2.6	6.5	171.42	24367	240.62	-0.2
240.12	2.4	6.5	171.47	24156	240.72	-0.1
240.22	2.9	6.5	171.52	23545	240.82	0
240.32	3.5	6.5	171.57	24317	240.92	-0.1
240.42	2.8	6.5	171.62	23948	241.02	0
240.52	2.4	6.5	171.67	24267	241.12	-0.1
240.62	2.4	6.5	171.73	24276	241.22	0
240.72	3	6.5	171.77	24588	241.32	0
240.82	3.3	6.5	171.82	24221	241.42	0
240.92	4.4	6.5	171.87	24020	241.52	0
241.02	4.3	6.5	171.92	24386	241.62	-0.1
241.12	3.4	6.5	171.97	23738	241.72	-0.1
241.22	2.3	6.5	172.02	24019	241.82	0
241.32	1.8	6.5	172.07	24203	241.92	0
241.42	1.6	6.5	172.12	24747	242.02	0
241.52	2.7	6.5	172.17	23777	242.12	-0.1
241.62	2.9	6.5	172.22	24402	242.22	-0.1
241.72	2.5	6.5	172.27	24378	242.32	-0.1
241.82	1.2	6.5	172.32	24222	242.42	-0.1

241.92	0.6	6.5	172.37	24455	242.52	-0.1
242.02	0.7	6.5	172.42	24067	242.62	-0.1
242.12	1	6.5	172.47	24009	242.72	-0.1
242.22	1.4	6.5	172.52	24009	242.82	-0.1
242.32	1.7	6.5	172.57	24303	242.92	-0.1
242.42	1.8	6.5	172.62	23831	243.02	-0.1
242.52	1.9	6.5	172.67	24345	243.12	-0.2
242.62	2.3	6.5	172.72	23888	243.22	-0.1
242.72	2.2	6.5	172.77	23875	243.32	-0.1
242.82	2.3	6.5	172.82	24659	243.42	-0.1
242.92	2.7	6.5	172.87	24086	243.52	-0.1
243.02	2.5	6.5	172.92	24125	243.62	-0.2
243.12	3.1	6.5	172.97	24776	243.72	-0.1
243.22	3	6.5	173.02	24057	243.82	-0.1
243.32	3.3	6.5	173.07	24477	243.92	-0.2
243.42	3.3	6.5	173.12	24311	244.02	-0.1
243.52	3.1	6.5	173.17	24666	244.12	-0.2
243.62	2.8	6.5	173.22	24883	244.22	-0.1
243.72	2.3	6.5	173.27	24376	244.32	-0.1
243.82	2.2	6.5	173.32	24970	244.42	-0.1
243.92	2.8	6.5	173.37	24831	244.52	-0.1
244.02	2.6	6.5	173.42	24661	244.62	-0.1
244.12	3.2	6.5	173.47	24695	244.72	-0.1
244.22	3	6.5	173.52	24898	244.82	-0.1
244.32	2.9	6.5	173.57	24400	244.92	-0.1
244.42	3	6.5	173.62	25040	245.02	-0.1
244.52	2.6	6.5	173.67	24959	245.12	-0.1
244.62	2.4	6.5	173.72	24738	245.22	-0.1
244.72	2.3	6.5	173.77	24352	245.32	-0.1
244.82	2.5	6.5	173.82	24477	245.42	0
244.92	3.2	6.5	173.87	24400	245.52	0
245.02	3.8	6.5	173.92	25205	245.62	-0.1
245.12	4.2	6.5	173.97	24835	245.72	-0.1
245.22	3	6.5	174.02	24355	245.82	0
245.32	1.8	6.5	174.07	24358	245.92	-0.1
245.42	2	6.5	174.12	24497	246.02	-0.1
245.52	4	6.5	174.17	24292	246.12	-0.1
245.62	3.3	6.5	174.22	23871	246.22	-0.1
245.72	3	6.5	174.27	24294	246.32	0
245.82	2.8	6.5	174.32	24386	246.42	-0.1
245.92	2.5	6.5	174.37	24952	246.52	-0.1
246.02	2.4	6.5	174.42	23904	246.62	-0.1
246.12	2.6	6.5	174.47	24243	246.72	-0.1
246.22	2.8	6.5	174.52	24149	246.82	-0.1
246.32	2.4	6.5	174.57	24276	246.92	-0.1
246.42	2.6	6.5	174.62	24281	247.02	0
246.52	2.6	6.5	174.67	23827	247.12	0
246.62	2.9	6.5	174.72	23692	247.22	0
246.72	1.9	6.5	174.77	24451	247.32	0
246.82	1.3	6.5	174.82	24500	247.42	0
246.92	1.5	6.5	174.87	23928	247.52	0
247.02	1	6.5	174.92	23995	247.62	0
247.12	1.5	6.5	174.97	23679	247.72	0
247.22	1.5	6.5	175.02	23889	247.82	-0.1
247.32	1.8	6.5	175.07	24278	247.92	0
247.42	1.5	6.5	175.12	24199	248.02	0

247.52	2.7	6.5	175.17	24073	248.12	0
247.62	3.2	6.5	175.22	24487	248.22	-0.1
247.72	2.4	6.5	175.27	24466	248.32	-0.1
247.82	1.6	6.5	175.32	23889	248.42	-0.1
247.92	1.3	6.5	175.37	24494	248.52	-0.1
248.02	1.3	6.5	175.42	24865	248.62	-0.1
248.12	1.2	6.5	175.47	24656	248.72	-0.1
248.22	1.4	6.5	175.52	24178	248.82	-0.2
248.32	1.2	6.5	175.57	25463	248.92	-0.1
248.42	1.3	6.5	175.62	25895	249.02	-0.1
248.52	1.4	6.5	175.67	25579	249.12	-0.1
248.62	1.4	6.5	175.72	25420	249.22	-0.1
248.72	1.7	6.5	175.77	24980	249.32	-0.1
248.82	1.7	6.5	175.82	25241	249.42	-0.1
248.92	1.6	6.5	175.87	24768	249.52	0
249.02	2.3	6.5	175.92	25151	249.62	-0.1
249.12	2.7	6.5	175.97	24985	249.72	0
249.22	2.6	6.5	176.02	26075	249.82	-0.1
249.32	2.3	6.5	176.07	25551	249.92	-0.1
249.42	1.8	6.5	176.12	25942	250.02	-0.2
249.52	1.4	6.5	176.17	25416	250.12	-0.1
249.62	1.4	6.5	176.22	24866	250.22	-0.1
249.72	1.4	6.5	176.27	25623	250.32	-0.1
249.82	1.8	6.5	176.32	25401	250.42	-0.1
249.92	2.4	6.5	176.37	25393	250.52	-0.1
250.02	2.6	6.5	176.42	25848	250.62	-0.1
250.12	2.5	6.5	176.47	25750	250.72	-0.1
250.22	2.7	6.5	176.52	25753	250.82	-0.1
250.32	1.9	6.5	176.57	26471	250.92	0
250.42	1.6	6.5	176.62	25920	251.02	0
250.52	1.5	6.5	176.67	27017	251.12	0
250.62	1.4	6.5	176.72	25750	251.22	-0.1
250.72	2.2	6.5	176.77	25979	251.32	0
250.82	2	6.5	176.82	25834	251.42	0
250.92	1.7	6.5	176.87	26057	251.52	0
251.02	1.8	6.5	176.92	25692	251.62	0
251.12	1.6	6.5	176.97	26736	251.72	0
251.22	1.5	6.5	177.02	26010	251.82	0
251.32	1.7	6.5	177.07	26373	251.92	0
251.42	1.6	6.5	177.12	26557	252.02	0
251.52	1.6	6.5	177.17	25643	252.12	-0.1
251.62	1.5	6.5	177.22	26353	252.22	-0.1
251.72	1.2	6.5	177.27	26428	252.32	-0.1
251.82	1	6.5	177.32	26427	252.42	-0.1
251.92	0.8	6.5	177.37	25796	252.52	0
252.02	0.5	6.5	177.42	25570	252.62	0
252.12	0.4	6.5	177.47	25995	252.72	0.1
252.22	0.6	6.5	177.52	25994	252.82	0
252.32	0.7	6.5	177.57	26572	252.92	0.1
252.42	0.8	6.5	177.62	25942	253.02	0.1
252.52	0.9	6.5	177.67	25710	253.12	0.1
252.62	1.1	6.5	177.72	26112	253.22	0.1
252.72	1.1	6.5	177.77	26586	253.32	0.1
252.82	1.1	6.5	177.82	26360	253.42	0.1
252.92	1.3	6.5	177.87	25911	253.52	0.1
253.02	1.3	6.5	177.92	26526	253.62	0

253.12	1.3	6.5	177.97	26028	253.72	0
253.22	1.4	6.5	178.02	26266	253.82	-0.1
253.32	1.4	6.5	178.07	26477	253.92	-0.1
253.42	1.3	6.5	178.12	26687	254.02	-0.1
253.52	1	6.5	178.17	25976	254.12	-0.1
253.62	1.1	6.5	178.22	26142	254.22	0
253.72	1.5	6.5	178.27	27301	254.32	0
253.82	1.6	6.5	178.32	25944	254.42	0
253.92	1.8	6.5	178.37	26595	254.52	0
254.02	1.6	6.5	178.42	26800	254.62	-0.1
254.12	1.4	6.5	178.47	26855	254.72	-0.1
254.22	1	6.5	178.52	26822	254.82	-0.1
254.32	0.3	6.5	178.57	26736	254.92	0.1
254.42	0.2	6.5	178.62	27085	255.02	0
254.52	0.3	6.5	178.67	27603	255.12	0.1
254.62	1.9	6.5	178.72	27112	255.22	0
254.72	2.4	6.5	178.77	26731	255.32	0
254.82	1.8	6.5	178.82	26580	255.42	0
254.92	1.5	6.5	178.87	27021	255.52	0
255.02	2	6.5	178.92	26622	255.62	0
255.12	2.2	6.5	178.97	27468	255.72	0
255.22	2.1	6.5	179.02	27647	255.82	-0.1
255.32	1.9	6.5	179.07	27319	255.92	0
255.42	1.8	6.5	179.12	27025	256.02	0
255.52	2	6.5	179.17	27323	256.12	0
255.62	2	6.5	179.22	27686	256.22	0
255.72	2.3	6.5	179.27	27788	256.32	0.1
255.82	2.5	6.5	179.32	27600	256.42	0
255.92	1.2	6.5	179.37	27677	256.52	0
256.02	1.4	6.5	179.42	28010	256.62	0
256.12	1.8	6.5	179.47	28464	256.72	0
256.22	1.5	6.5	179.52	28050	256.82	-0.1
256.32	1.1	6.5	179.57	27942	256.92	0
256.42	1.2	6.5	179.62	28273	257.02	0
256.52	1.2	6.5	179.67	28412	257.12	0
256.62	1.7	6.5	179.72	28403	257.22	-0.1
256.72	2	6.5	179.77	28358	257.32	0
256.82	2.4	6.5	179.82	28233	257.42	-0.1
256.92	2.1	6.5	179.87	27893	257.52	-0.1
257.02	1.9	6.5	179.92	27994	257.62	0
257.12	2.2	6.5	179.97	27500	257.72	0
257.22	2.1	6.5	180.02	28607	257.82	0
257.32	1.2	6.5	180.07	28695	257.92	0.1
257.42	1.7	6.5	180.12	28623	258.02	0.1
257.52	1.5	6.5	180.17	27378	258.12	0
257.62	1.3	6.5	180.22	27595	258.22	0.1
257.72	1.4	6.5	180.27	27552	258.32	0
257.82	1.5	6.5	180.32	26275	258.42	0
257.92	1.5	6.5	180.37	27752	258.52	0
258.02	1.9	6.5	180.42	27207	258.62	0
258.12	2	6.5	180.47	27267	258.72	0
258.22	2.2	6.5	180.52	28024	258.82	-0.1
258.32	2.1	6.5	180.57	27403	258.92	0
258.42	2	6.5	180.62	26560	259.02	0
258.52	2.4	6.5	180.67	27203	259.12	0
258.62	3.1	6.5	180.72	26967	259.22	0

258.72	3	6.5	180.77	26173	259.32	0
258.82	2.5	6.5	180.82	26186	259.42	0
258.92	2.5	6.5	180.87	26100	259.52	0
259.02	2.9	6.5	180.92	25734	259.62	0
259.12	3	6.5	180.97	25588	259.72	0
259.22	2.7	6.5	181.02	25451	259.82	0
259.32	2.4	6.5	181.07	25380	259.92	-0.1
259.42	2.7	6.5	181.12	24240	260.02	0
259.52	2.5	6.5	181.17	24908	260.12	0.1
259.62	2.5	6.5	181.22	25510	260.22	0.1
259.72	2.8	6.5	181.27	24211	260.32	0.1
259.82	3	6.5	181.32	25009	260.42	0.1
259.92	3.6	6.5	181.37	25074	260.52	0.1
260.02	2.9	6.5	181.42	24781	260.62	0
260.12	2.3	6.5	181.47	24607	260.72	0.1
260.22	1.5	6.5	181.52	24729	260.82	0
260.32	1.3	6.5	181.57	24576	260.92	0
260.42	1.5	6.5	181.62	24460	261.02	0
260.52	1.2	6.5	181.67	24338	261.12	0
260.62	1.8	6.5	181.72	24174	261.22	-0.1
260.72	2.6	6.5	181.77	23857	261.32	0
260.82	3	6.5	181.82	23741	261.42	-0.1
260.92	2.9	6.5	181.87	24012	261.52	0
261.02	3.3	6.5	181.92	23813	261.62	0
261.12	2.6	6.5	181.97	24103	261.72	0
261.22	3.2	6.5	182.02	23396	261.82	0
261.32	2.7	6.5	182.07	23678	261.92	0
261.42	2.6	6.5	182.12	24274	262.02	0
261.52	2.8	6.5	182.17	24223	262.12	0
261.62	3.3	6.5	182.22	23472	262.22	0
261.72	3.4	6.5	182.27	23222	262.32	0
261.82	3	6.5	182.32	23502	262.42	0
261.93	3	6.5	182.37	23385	262.53	0
262.03	2.8	6.5	182.42	23708	262.63	0
262.13	2.5	6.5	182.47	23356	262.73	0
262.23	1.8	6.5	182.52	23544	262.83	0
262.33	2.5	6.5	182.57	23126	262.93	0
262.43	3.3	6.5	182.62	22821	263.03	0
262.53	2.9	6.5	182.67	23031	263.13	0
262.63	2.9	6.5	182.72	23108	263.23	0
262.73	2.5	6.5	182.77	22903	263.33	0
262.83	2.3	6.5	182.82	24166	263.43	0
262.94	2.7	6.5	182.87	23093	263.54	0
263.04	2.9	6.5	182.92	23634	263.64	0
263.14	2.9	6.5	182.97	22410	263.74	0
263.24	2.8	6.5	183.02	23391	263.84	0
263.34	2.8	6.5	183.07	23790	263.94	0
263.44	2.1	6.5	183.12	23302	264.04	0
263.54	2.3	6.5	183.17	23724	264.14	0
263.64	2.2	6.5	183.22	23475	264.24	-0.1
263.74	2.8	6.5	183.27	23757	264.34	0
263.84	2.5	6.5	183.32	23514	264.44	0
263.95	2.1	6.5	183.37	23638	264.55	0.1
264.05	2.5	6.5	183.42	24085	264.65	0.1
264.15	2.7	6.5	183.47	24004	264.75	0.1
264.25	2.5	6.5	183.52	23479	264.85	0

264.35	2.4	6.5	183.57	23668	264.95	0
264.45	2.3	6.5	183.62	24039	265.05	-0.1
264.55	2.1	6.5	183.67	23351	265.15	0
264.65	1.9	6.5	183.71	24035	265.25	-0.1
264.75	2.8	6.5	183.76	23573	265.35	-0.1
264.85	3.6	6.5	183.81	24353	265.45	-0.1
264.96	3.8	6.5	183.86	24122	265.56	0
265.06	3.9	6.5	183.91	23610	265.66	0
265.16	3.9	6.5	183.96	23782	265.76	0
265.26	3.9	6.5	184.01	23651	265.86	-0.1
265.36	3.9	6.5	184.06	23578	265.96	0
265.46	3.4	6.5	184.11	24360	266.06	-0.1
265.56	2.2	6.5	184.16	24358	266.16	-0.1
265.66	2.6	6.5	184.21	24010	266.26	-0.1
265.76	2.3	6.5	184.26	23507	266.36	-0.1
265.86	1.8	6.5	184.31	24065	266.46	0
265.97	1.5	6.5	184.36	24065	266.57	-0.1
266.07	1.8	6.5	184.41	23643	266.67	0
266.17	2.1	6.5	184.46	23905	266.77	0
266.27	2.6	6.5	184.51	24065	266.87	0
266.37	1.1	6.5	184.56	23619	266.97	0.1
266.47	1.2	6.5	184.61	23969	267.07	0
266.57	1.7	6.5	184.66	23018	267.17	0.1
266.67	1.9	6.5	184.71	23642	267.27	0
266.77	1.5	6.5	184.76	23625	267.37	0
266.88	1.1	6.5	184.81	23958	267.48	0
266.98	0.9	6.5	184.86	24108	267.58	0
267.08	0.9	6.5	184.91	23720	267.68	0
267.18	1.6	6.5	184.96	23980	267.78	0
267.28	1.6	6.5	185.01	24034	267.88	0.1
267.38	1	6.5	185.06	23918	267.98	0.1
267.48	1.3	6.5	185.11	24629	268.08	0.1
267.58	1.5	6.5	185.16	24685	268.18	0
267.68	1.8	6.5	185.21	24261	268.28	0.1
267.78	1.7	6.5	185.26	25104	268.38	0.1
267.89	1.5	6.5	185.31	25096	268.49	0
267.99	1.2	6.5	185.36	24975	268.59	0.1
268.09	1.2	6.5	185.41	25533	268.69	0
268.19	0.9	6.5	185.46	24825	268.79	0
268.29	0.9	6.5	185.51	25280	268.89	0.1
268.39	0.9	6.5	185.56	24994	268.99	0
268.49	1.1	6.5	185.61	25340	269.09	0.1
268.59	1	6.5	185.66	24290	269.19	0
268.69	1	6.5	185.7	23950	269.29	0
268.79	0.7	6.5	185.75	24321	269.39	0
268.9	0.8	6.5	185.8	24360	269.5	0
269	0.7	6.5	185.85	24127	269.6	-0.1
269.1	0.5	6.5	185.9	23859	269.7	-0.1
269.2	0.2	6.5	185.95	24100	269.8	-0.1
269.3	0.3	6.5	186	24355	269.9	-0.1
269.4	0.2	6.5	186.05	23966	270	0
269.5	0.1	6.5	186.1	24649	270.1	0
269.6	0.3	6.5	186.15	24546	270.2	0
269.7	0.6	6.5	186.2	24201	270.3	0.1
269.8	1	6.5	186.25	23939	270.4	0
269.91	1.1	6.5	186.3	23473	270.51	0

270.01	1.1	6.5	186.35	23623	270.61	0
270.11	1.3	6.5	186.4	23711	270.71	0
270.21	1.1	6.5	186.45	24025	270.81	0
270.31	1.5	6.5	186.5	24266	270.91	-0.1
270.41	1.8	6.5	186.55	23547	271.01	-0.1
270.51	1.6	6.5	186.6	23979	271.11	-0.1
270.61	2.2	6.5	186.65	24120	271.21	-0.1
270.71	2.8	6.5	186.7	23783	271.31	-0.1
270.81	2.6	6.5	186.75	23785	271.41	0
270.92	2.9	6.5	186.8	23609	271.52	-0.1
271.02	3.2	6.5	186.85	23568	271.62	-0.1
271.12	3.4	6.5	186.9	23939	271.72	0
271.22	3.3	6.5	186.95	23925	271.82	0
271.32	3.5	6.5	187	24102	271.92	0
271.42	1.8	6.5	187.05	24718	272.02	0
271.52	1.4	6.5	187.1	24550	272.12	-0.1
271.62	2.5	6.5	187.15	24399	272.22	-0.1
271.72	3.4	6.5	187.2	24793	272.32	-0.1
271.82	3.6	6.5	187.25	24513	272.42	-0.1
271.92	2.5	6.5	187.3	24637	272.52	-0.1
272.02	3	6.5	187.35	24849	272.62	-0.1
272.12	4.1	6.5	187.4	25463	272.72	-0.2
272.22	4.3	6.5	187.45	25768	272.82	-0.2
272.32	4.7	6.5	187.5	25835	272.92	-0.2
272.42	4.3	6.5	187.55	25688	273.02	-0.2
272.52	3.3	6.5	187.6	25814	273.12	-0.3
272.62	4	6.5	187.65	26145	273.22	-0.2
272.72	4.9	6.5	187.7	24928	273.32	-0.2
272.82	4.6	6.5	187.74	26192	273.42	-0.1
272.92	4.5	6.5	187.79	25772	273.52	-0.1
273.02	4.6	6.5	187.84	25252	273.62	-0.1
273.12	4	6.5	187.89	25266	273.72	0
273.22	4.4	6.5	187.94	24814	273.82	-0.1
273.32	4.6	6.5	187.99	25032	273.92	-0.1
273.42	4.5	6.5	188.04	23806	274.02	-0.1
273.52	4.3	6.5	188.09	25177	274.12	-0.1
273.62	4.2	6.5	188.14	24671	274.22	0
273.72	3.1	6.5	188.19	24852	274.32	-0.1
273.82	3.7	6.5	188.24	25510	274.42	0
273.92	2.4	6.5	188.29	24858	274.52	-0.1
274.02	2.3	6.5	188.34	25123	274.62	0
274.12	2.9	6.5	188.39	24387	274.72	-0.1
274.22	3.4	6.5	188.44	25239	274.82	-0.1
274.32	2.7	6.5	188.49	25360	274.92	-0.1
274.42	2.4	6.5	188.54	24935	275.02	-0.1
274.52	2.2	6.5	188.59	24880	275.12	-0.2
274.62	2.4	6.5	188.64	24979	275.22	-0.1
274.72	2.4	6.5	188.69	24889	275.32	0
274.82	1.9	6.5	188.74	24295	275.42	0
274.92	1.8	6.5	188.79	25010	275.52	0
275.02	1.5	6.5	188.84	24786	275.62	0
275.12	1.3	6.5	188.89	24603	275.72	0
275.22	1.5	6.5	188.94	24737	275.82	0
275.32	1.9	6.5	188.99	25258	275.92	0
275.42	1.5	6.5	189.04	24620	276.02	0
275.52	1.6	6.5	189.09	26792	276.12	-0.1

275.62	1.9	6.5	189.14	25454	276.22	-0.1
275.72	1.5	6.5	189.19	25437	276.32	-0.1
275.82	1.4	6.5	189.24	24811	276.42	-0.1
275.92	2	6.5	189.29	24994	276.52	-0.1
276.02	2	6.5	189.34	24824	276.62	-0.1
276.12	1.9	6.5	189.39	25000	276.72	-0.1
276.22	1.8	6.5	189.44	24691	276.82	-0.1
276.32	1.8	6.5	189.49	24379	276.92	-0.1
276.42	1.8	6.5	189.54	25325	277.02	-0.2
276.52	2.2	6.5	189.59	25044	277.12	-0.1
276.62	2.2	6.5	189.64	24622	277.22	-0.1
276.72	1.8	6.5	189.69	24895	277.32	0
276.82	1.3	6.5	189.73	24246	277.42	-0.1
276.92	1.5	6.5	189.78	24632	277.52	-0.1
277.02	1.6	6.5	189.83	24631	277.62	-0.1
277.12	1.6	6.5	189.88	24382	277.72	-0.1
277.22	1.5	6.5	189.93	24390	277.82	-0.1
277.32	2.3	6.5	189.98	24471	277.92	-0.1
277.42	3.1	6.5	190.03	24722	278.02	-0.2
277.52	3.7	6.5	190.08	25171	278.12	-0.1
277.62	3.9	6.5	190.13	24708	278.22	-0.1
277.72	3.3	6.5	190.18	24495	278.32	-0.2
277.82	3	6.5	190.23	25038	278.42	-0.2
277.92	3.4	6.5	190.28	24470	278.52	-0.2
278.02	3.4	6.5	190.33	24536	278.62	-0.1
278.12	3.1	6.5	190.38	24086	278.72	-0.1
278.22	3.5	6.5	190.43	24520	278.82	0
278.32	3.8	6.5	190.48	24584	278.92	-0.1
278.42	3.6	6.5	190.53	24573	279.02	-0.1
278.52	2.6	6.5	190.58	24613	279.12	-0.1
278.62	2.6	6.5	190.63	25043	279.22	-0.1
278.72	1.8	6.5	190.68	25046	279.32	-0.1
278.82	1.5	6.5	190.73	24924	279.42	-0.1
278.92	2.4	6.5	190.78	25711	279.52	-0.1
279.02	3.3	6.5	190.83	25198	279.62	-0.1
279.12	3.4	6.5	190.88	25530	279.72	-0.1
279.22	2.3	6	190.93	24650	279.82	-0.2
279.32	2.8	6	190.98	25586	279.92	-0.2
279.42	2.8	6	191.03	25269	280.02	-0.2
279.52	1.6	6	191.08	24853	280.12	-0.2
279.62	2.9	6	191.13	24806	280.22	-0.1
279.72	3.5	6	191.18	24315	280.32	-0.1
279.82	3.4	6	191.23	24498	280.42	-0.1
279.92	3.6	6	191.28	24511	280.52	0
280.02	2.7	6	191.33	24498	280.62	0
280.12	1.7	6	191.38	24565	280.72	-0.1
280.22	1.5	6	191.43	25014	280.82	-0.1
280.32	2	6	191.48	24607	280.92	-0.1
280.42	2.2	6	191.53	24953	281.02	-0.1
280.52	2.3	6	191.58	25723	281.12	-0.1
280.62	2.1	6	191.63	25100	281.22	-0.1
280.72	4.4	6	191.68	24885	281.32	-0.1
280.82	3.6	6	191.72	24719	281.42	-0.1
280.92	3	6	191.78	24897	281.52	-0.1
281.02	3	6	191.83	24192	281.62	-0.1
281.12	4.1	6	191.88	25564	281.72	0

281.22	4.2	6	191.93	25148	281.82	0
281.32	2.7	6	191.98	24343	281.92	0
281.42	2.8	6	192.03	24529	282.02	-0.1
281.52	3.3	6	192.08	24544	282.12	-0.2
281.62	2.5	6	192.13	24865	282.22	-0.2
281.72	3.1	6	192.18	24694	282.32	-0.2
281.82	3.5	6	192.23	25359	282.42	-0.2
281.92	2.9	6	192.28	24797	282.52	-0.2
282.02	3.7	6	192.33	25244	282.62	-0.2
282.12	4	6	192.38	24784	282.72	-0.2
282.22	2.5	6	192.43	24498	282.82	-0.1
282.32	2.1	6	192.48	24811	282.92	-0.2
282.42	2.8	6	192.53	24857	283.02	-0.1
282.52	2.4	6	192.58	25616	283.12	-0.1
282.62	2	6	192.63	25095	283.22	-0.1
282.72	2	6	192.68	25400	283.32	-0.1
282.82	2	6	192.73	24752	283.42	-0.1
282.92	2	6	192.78	25150	283.52	-0.1
283.02	2.5	6	192.83	24625	283.62	-0.2
283.12	2.8	6	192.88	25025	283.72	-0.1
283.22	3	6	192.93	25565	283.82	-0.1
283.32	3.1	6	192.98	25365	283.92	-0.1
283.42	2.7	6	193.03	24895	284.02	-0.1
283.52	2.4	6	193.08	25071	284.12	-0.1
283.62	2.1	6	193.13	25253	284.22	-0.2
283.72	1.5	6	193.18	25099	284.32	-0.2
283.82	1.5	6	193.23	24796	284.42	-0.2
283.92	2.1	6	193.28	25898	284.52	-0.1
284.02	3.3	6	193.33	24815	284.62	0
284.12	3.2	6	193.38	25926	284.72	0
284.22	3.1	6	193.43	25458	284.82	0
284.32	3	6	193.48	24601	284.92	0
284.42	2.8	6	193.53	25647	285.02	0
284.52	2.2	6	193.58	26092	285.12	0
284.62	1.2	6	193.63	25513	285.22	0
284.72	1	6	193.68	25425	285.32	0
284.82	0.9	6	193.74	24409	285.42	0
284.92	1.2	6	193.79	24870	285.52	-0.1
285.02	1.2	6	193.84	24881	285.62	-0.1
285.12	1.2	6	193.89	24986	285.72	-0.1
285.22	1.2	6	193.94	25083	285.82	-0.1
285.32	1.2	6	193.99	24758	285.92	-0.1
285.42	1.1	6	194.04	25258	286.02	-0.1
285.52	1.1	6	194.09	24293	286.12	-0.1
285.62	0.8	6	194.14	24132	286.22	-0.1
285.72	0.7	6	194.19	25000	286.32	-0.1
285.82	0.7	6	194.24	24957	286.42	0
285.92	0.7	6	194.29	25149	286.52	0
286.02	0.6	6	194.34	25334	286.62	0
286.12	0.4	6	194.39	24352	286.72	0
286.22	0.2	6	194.44	25805	286.82	0
286.32	0.3	6	194.49	24833	286.92	0
286.42	0.5	6	194.54	25075	287.02	-0.1
286.52	0.4	6	194.59	24932	287.12	-0.1
286.62	0.4	6	194.64	25245	287.22	-0.1
286.72	0.2	6	194.69	24100	287.32	-0.1

286.82	0.2	6	194.74	25178	287.42	-0.1
286.92	0.3	6	194.79	24595	287.52	-0.1
287.02	0.2	6	194.84	24273	287.62	-0.1
287.12	0.4	6	194.89	24583	287.72	-0.1
287.22	0.5	6	194.94	24178	287.82	-0.1
287.32	0.4	6	194.99	25181	287.92	-0.1
287.42	0.4	6	195.04	25584	288.02	-0.1
287.52	0.2	6	195.09	25230	288.12	0
287.62	0.2	6	195.14	25959	288.22	0
287.72	0.3	6	195.19	26074	288.32	-0.1
287.82	0.4	6	195.24	25514	288.42	0
287.92	0.6	6	195.29	25094	288.52	-0.1
288.02	0.9	6	195.34	24925	288.62	-0.1
288.12	1.1	6	195.39	24837	288.72	0
288.22	1.1	6	195.44	24826	288.82	0
288.32	0.8	6	195.49	24940	288.92	-0.1
288.42	0.6	6	195.54	24954	289.02	-0.1
288.52	0.5	6	195.59	25092	289.12	-0.1
288.62	0.5	6	195.64	24263	289.22	0
288.72	0.5	6	195.69	25470	289.32	0
288.82	0.3	6	195.75	25568	289.42	0.1
288.92	0.2	6	195.8	25069	289.52	0.1
289.02	0.3	6	195.85	25181	289.62	0.1
289.12	0.4	6	195.9	24563	289.72	0
289.22	0.4	6	195.95	24021	289.82	0
289.32	0.3	6	196	23823	289.92	0
289.42	0.2	6	196.05	25210	290.02	-0.1
289.52	0.1	6	196.1	25082	290.12	0
289.62	0.1	6	196.15	24451	290.22	-0.1
289.72	0.2	6	196.2	24850	290.32	-0.1
289.82	0.4	6	196.25	24854	290.42	0
289.92	0.6	6	196.3	24569	290.52	0
290.02	0.6	6	196.35	24786	290.62	0
290.12	0.4	6	196.4	24336	290.72	-0.1
290.22	0.4	6	196.45	25746	290.82	-0.1
290.32	0.3	6	196.5	24950	290.92	-0.1
290.42	0.2	6	196.55	24383	291.02	-0.1
290.52	0.1	6	196.6	24670	291.12	0
290.62	0.1	6	196.65	24588	291.22	0
290.72	0.1	6	196.7	24797	291.32	0.1
290.82	0.2	6	196.75	24644	291.42	0
290.92	0.1	6	196.8	24748	291.52	0
291.02	0.2	6	196.85	24559	291.62	0
291.12	0.5	6	196.9	23772	291.72	0
291.22	0.8	6	196.95	24201	291.82	0
291.32	0.9	6	197	23661	291.92	-0.1
291.42	0.5	6	197.05	25407	292.02	-0.1
291.52	0.4	6	197.1	25471	292.12	-0.1
291.62	0.7	6	197.15	26252	292.22	-0.1
291.72	0.7	6	197.2	26062	292.32	-0.1
291.82	0.8	6	197.25	26401	292.42	0
291.92	0.6	6	197.3	26039	292.52	-0.1
292.02	0.5	6	197.35	26138	292.62	-0.1
292.12	0.5	6	197.4	25495	292.72	-0.1
292.22	0.4	6	197.45	26976	292.82	-0.1
292.32	0.3	6	197.5	27155	292.92	-0.1

292.42	0.3	6	197.55	27369	293.02	0
292.52	0.5	6	197.6	26356	293.12	0.1
292.62	0.5	6	197.65	26958	293.22	0
292.72	0.3	6	197.71	26352	293.32	0
292.82	0.4	6	197.76	26846	293.42	0
292.92	0.5	6	197.81	26513	293.52	-0.1
293.02	0.5	6.75	197.86	26469	293.62	-0.1
293.12	0.5	6.75	197.91	27443	293.72	-0.1
293.22	0.9	6.75	197.96	26465	293.82	-0.1
293.32	1	6.75	198.01	26852	293.92	-0.1
293.42	0.7	6.75	198.06	26989	294.02	-0.1
293.52	0.5	6.75	198.11	27020	294.12	-0.1
293.62	0.4	6.75	198.16	26700	294.22	-0.1
293.72	0.2	6.75	198.21	27027	294.32	-0.1
293.82	0.3	6.75	198.26	27078	294.42	0
293.92	0.2	6.75	198.31	26258	294.52	0.1
294.02	0.2	6.75	198.36	27243	294.62	0
294.12	0.1	6.75	198.41	26117	294.72	0
294.22	0.1	6.75	198.46	27086	294.82	0
294.32	0.2	6.75	198.51	26756	294.92	0
294.42	0.2	6.75	198.56	26768	295.02	-0.1
294.52	0.2	6.75	198.61	26516	295.12	-0.1
294.62	0.4	6.75	198.66	26260	295.22	-0.1
294.72	0.6	6.75	198.71	26258	295.32	-0.1
294.82	0.5	6.75	198.76	26886	295.42	-0.1
294.92	0.6	6.75	198.81	26988	295.52	-0.1
295.02	0.6	6.75	198.86	27171	295.62	-0.1
295.12	0.5	6.75	198.91	27552	295.72	-0.1
295.22	0.5	6.75	198.96	27815	295.82	0
295.32	0.5	6.75	199.01	27106	295.92	0
295.42	0.4	6.75	199.06	26556	296.02	0
295.52	0.4	6.75	199.11	26773	296.12	0.1
295.62	0.3	6.75	199.16	26940	296.22	0
295.72	0.3	6.75	199.21	26751	296.32	0
295.82	0.3	6.75	199.26	27115	296.42	0
295.92	0.2	6.75	199.31	27126	296.52	0
296.02	0.1	6.75	199.36	28889	296.62	0
296.12	0.1	6.75	199.41	27827	296.72	0
296.22	0.2	6.75	199.46	28566	296.82	0
296.32	0.4	6.75	199.51	27969	296.92	-0.1
296.42	0.4	6.75	199.56	27484	297.02	0
296.52	0.3	6.75	199.61	26174	297.12	-0.1
296.62	0.4	6.75	199.66	26187	297.22	-0.1
296.72	0.4	6.75	199.72	25868	297.32	-0.1
296.82	0.5	6.75	199.77	26143	297.42	0
296.92	0.6	6.75	199.82	25620	297.52	-0.1
297.02	0.5	6.75	199.87	25865	297.62	-0.1
297.12	0.5	6.75	199.92	25940	297.72	0
297.22	0.5	6.75	199.97	26197	297.82	-0.1
297.32	0.5	6.75	200.02	26506	297.92	-0.1
297.42	0.4	6.75	200.07	27273	298.02	-0.1
297.52	0.4	6.75	200.12	27102	298.12	-0.1
297.62	0.5	6.75	200.17	27112	298.22	0
297.72	0.6	6.75	200.22	27146	298.32	0.1
297.82	0.6	6.75	200.27	27620	298.42	0
297.92	0.6	6.75	200.32	27810	298.52	-0.1

298.02	0.5	6.75	200.37	27484	298.62	0
298.12	0.6	6.75	200.42	27843	298.72	0
298.22	0.7	6.75	200.47	27633	298.82	0
298.32	0.7	6.75	200.52	27378	298.92	0
298.42	0.8	6.75	200.57	26827	299.02	-0.1
298.52	1	6.75	200.62	26941	299.12	0
298.62	0.8	6.75	200.67	27125	299.22	-0.1
298.72	0.6	6.75	200.72	26433	299.32	0
298.82	0.5	6.75	200.77	26496	299.42	-0.1
298.92	0.4	6.75	200.82	27053	299.52	0
299.02	0.3	6.75	200.87	26261	299.62	0
299.12	0.3	6.75	200.92	26593	299.72	0.1
299.22	0.2	6.75	200.97	26820	299.82	0
299.32	0.2	6.75	201.02	27922	299.92	0.1
299.42	0.2	6.75	201.07	27551	300.02	0
299.52	0.2	6.75	201.12	29129	300.12	0.1
299.62	0.3	6.75	201.17	30000	300.22	0
299.72	0.3	6.75	201.22	29803	300.32	0
299.82	0.2	6.75	201.27	29231	300.42	-0.1
299.92	0.1	6.75	201.32	28831	300.52	-0.1
300.02	0	6.75	201.37	27361	300.62	0
300.12	-0.1	6.75	201.42	28005	300.72	0
300.22	-0.1	6.75	201.47	27023	300.82	-0.1
300.32	0.2	6.75	201.52	27132	300.92	-0.1
300.42	0.3	6.75	201.57	27010	301.02	-0.1
300.52	0.1	6.75	201.62	26352	301.12	-0.1
300.62	0	6.75	201.67	26956	301.22	0
300.72	0.1	6.75	201.73	26741	301.32	0.1
300.82	0.2	6.75	201.77	26749	301.42	0
300.92	0.2	6.75	201.82	26809	301.52	0
301.02	0.1	6.75	201.87	27440	301.62	0
301.12	0.1	6.75	201.92	27405	301.72	0
301.22	0	6.75	201.97	26875	301.82	0
301.32	0	6.75	202.02	26555	301.92	-0.1
301.42	0.1	6.75	202.07	26908	302.02	-0.1
301.52	0.3	6.75	202.12	26852	302.12	-0.1
301.62	0.5	6.75	202.17	26423	302.22	-0.2
301.72	0.3	6.75	202.22	26625	302.32	-0.1
301.82	0.3	6.75	202.27	25556	302.42	-0.1
301.93	0.4	6.75	202.32	25718	302.53	-0.2
302.03	0.5	8.5	202.37	25274	302.63	-0.2
302.13	0.9	8.5	202.42	25112	302.73	0
302.23	0.8	8.5	202.47	26577	302.83	0
302.33	0.6	8.5	202.52	27327	302.93	0
302.43	0.6	8.5	202.57	27318	303.03	0
302.53	0.8	8.5	202.62	27592	303.13	0
302.63	0.9	8.5	202.67	27077	303.23	0
302.73	0.7	8.5	202.72	27482	303.33	0
302.83	0.3	8.5	202.77	27195	303.43	0
302.94	0.2	8.5	202.82	26363	303.54	-0.1
303.04	0.3	8.5	202.87	26508	303.64	-0.1
303.14	1	8.5	202.92	27218	303.74	-0.1
303.24	1.4	8.5	202.97	26684	303.84	-0.1
303.34	1.2	8.5	203.02	26477	303.94	-0.1
303.44	1.2	8.5	203.07	26186	304.04	-0.1
303.54	1.1	8.5	203.12	26126	304.14	-0.2

303.64	1.3	8.5	203.17	26887	304.24	-0.2
303.74	1.2	8.5	203.22	26714	304.34	-0.1
303.84	1.3	8.5	203.27	27390	304.44	0
303.95	1.6	8.5	203.32	26490	304.55	0
304.05	1.6	8.5	203.37	27250	304.65	-0.1
304.15	1.6	8.5	203.42	26262	304.75	0
304.25	1.6	8.5	203.47	26377	304.85	0
304.35	1.6	8.5	203.52	26866	304.95	-0.1
304.45	1.2	8.5	203.57	25982	305.05	-0.1
304.55	1.2	8.5	203.62	26331	305.15	-0.1
304.65	1.1	8.5	203.67	26350	305.25	-0.1
304.75	1.1	8.5	203.72	26704	305.35	0
304.85	1.2	8.5	203.77	27412	305.45	-0.1
304.96	1.3	8.5	203.82	27254	305.56	-0.1
305.06	1.1	8.5	203.87	27662	305.66	-0.1
305.16	0.9	8.5	203.92	27561	305.76	0
305.26	0.9	8.5	203.97	27301	305.86	0.1
305.36	0.8	8.5	204.02	27913	305.96	0
305.46	0.7	8.5	204.07	27170	306.06	0
305.56	0.8	8.5	204.12	27387	306.16	0
305.66	1.2	8.5	204.17	27203	306.26	-0.1
305.76	1.2	8.5	204.22	27888	306.36	-0.1
305.86	1.8	8.5	204.27	27404	306.46	-0.2
305.97	2.1	8.5	204.32	28000	306.57	-0.1
306.07	1.6	8.5	204.37	27895	306.67	-0.1
306.17	1.4	8.5	204.42	27263	306.77	-0.1
306.27	1.4	8.5	204.47	28346	306.87	-0.1
306.37	1.5	8.5	204.52	28090	306.97	-0.2
306.47	1.6	8.5	204.57	28173	307.07	-0.2
306.57	1.7	8.5	204.62	28887	307.17	0
306.67	1.6	8.5	204.67	28627	307.27	0
306.77	1.2	8.5	204.72	28424	307.37	0
306.88	1.4	8.5	204.77	28723	307.48	0.1
306.98	1.2	8.5	204.82	27201	307.58	0.1
307.08	1	8.5	204.87	27059	307.68	0
307.18	0.6	8.5	204.92	26751	307.78	0
307.28	0.8	8.5	204.97	27306	307.88	0
307.38	0.9	8.5	205.02	27185	307.98	-0.1
307.48	1	8.5	205.07	26920	308.08	-0.1
307.58	1.1	8.5	205.12	26071	308.18	-0.1
307.68	1.1	8.5	205.17	26210	308.28	-0.1
307.78	1.4	8.5	205.22	26745	308.38	-0.1
307.89	1.4	8.5	205.27	26087	308.49	-0.1
307.99	1.4	8.5	205.32	26163	308.59	-0.1
308.09	1.4	8.5	205.37	26218	308.69	-0.1
308.19	1.4	8.5	205.42	25944	308.79	-0.1
308.29	1.3	8.5	205.47	26591	308.89	-0.1
308.39	1.6	8.5	205.52	26889	308.99	0
308.49	1.6	8.5	205.57	26426	309.09	0
308.59	1.4	8.5	205.62	26377	309.19	0
308.69	1.1	8.5	205.67	25973	309.29	0
308.79	1	8.5	205.72	26193	309.39	0
308.9	0.9	8.5	205.77	25246	309.5	0
309	1	8.5	205.82	25172	309.6	0
309.1	1.1	8.5	205.87	25233	309.7	0
309.2	1.2	8.5	205.92	25216	309.8	0

309.3	1.3	8.5	205.97	25297	309.9	-0.1
309.4	1.4	8.5	206.02	24779	310	-0.1
309.5	1.5	8.5	206.07	24978	310.1	-0.1
309.6	1.3	8.5	206.12	24376	310.2	-0.1
309.7	1.2	8.5	206.17	24541	310.3	-0.2
309.8	1.2	8.5	206.22	23743	310.4	-0.2
309.91	1.1	8.5	206.27	24145	310.51	-0.1
310.01	1.1	8.5	206.32	23687	310.61	-0.1
310.11	1.1	8.5	206.37	24941	310.71	0
310.21	1.3	8.5	206.42	24782	310.81	0
310.31	1.3	8.5	206.47	24160	310.91	0
310.41	1.3	8.5	206.52	24122	311.01	0.1
310.51	1	8.5	206.57	24194	311.11	0.1
310.61	1	8.5	206.62	24285	311.21	0.1
310.71	1.2	8.5	206.67	23591	311.31	0.1
310.81	1.3	8.5	206.72	23538	311.41	0
310.92	1.4	8.5	206.77	24636	311.52	0
311.02	1.4	8.5	206.82	24428	311.62	0
311.12	1.6	8.5	206.87	24021	311.72	0
311.22	1.4	8.5	206.92	24021	311.82	-0.2
311.32	1.3	8.5	206.97	24321	311.92	-0.2
311.42	1.1	8.5	207.02	24190	312.02	-0.2
311.52	1.1	8.5	207.07	24375	312.12	-0.2
311.62	1.1	8.5	207.12	23206	312.22	-0.1
311.72	1.5	8.5	207.17	24185	312.32	-0.2
311.82	1.5	8.5	207.22	23763	312.42	-0.2
311.92	1.5	8.5	207.27	24642	312.52	-0.1
312.02	1.4	8.5	207.32	23987	312.62	-0.1
312.12	1.2	8.5	207.37	23863	312.72	0
312.22	1.3	8.5	207.42	23452	312.82	0
312.32	1.2	8.5	207.47	24203	312.92	0
312.42	1.3	8.5	207.52	24153	313.02	0.1
312.52	1.1	8.5	207.57	24125	313.12	0
312.62	1.2	8.5	207.62	23886	313.22	0
312.72	1.3	8.5	207.67	23859	313.32	-0.1
312.82	1.5	8.5	207.72	24371	313.42	-0.1
312.92	1.8	8.5	207.77	24387	313.52	0
313.02	1.9	8.5	207.82	24022	313.62	0
313.12	1.9	8.5	207.87	24409	313.72	-0.1
313.22	2	8.5	207.92	23924	313.82	-0.2
313.32	1.9	8.5	207.97	23600	313.92	-0.2
313.42	1.8	8.5	208.02	24216	314.02	-0.2
313.52	1.7	8.5	208.07	24359	314.12	0
313.62	1.9	8.5	208.12	23370	314.22	0
313.72	2	8.5	208.17	24494	314.32	0
313.82	1.9	8.5	208.22	24180	314.42	0
313.92	1.8	8.5	208.27	24173	314.52	-0.1
314.02	1.7	8.5	208.32	24250	314.62	-0.1
314.12	1.6	8.5	208.37	23461	314.72	0
314.22	1.6	8.5	208.42	24424	314.82	-0.1
314.32	1.4	8.5	208.47	24719	314.92	-0.1
314.42	1.6	8.5	208.52	24090	315.02	-0.1
314.52	1.5	8.5	208.57	23662	315.12	-0.1
314.62	1.4	8.5	208.62	24552	315.22	-0.1
314.72	1.4	8.5	208.67	23078	315.32	-0.2
314.82	1.4	8.5	208.72	23532	315.42	-0.1

314.92	2	8.5	208.77	24088	315.52	0.1
315.02	2.1	8.5	208.82	23605	315.62	0.1
315.12	2.2	8.5	208.87	23736	315.72	0.1
315.22	1.8	8.5	208.92	24167	315.82	0
315.32	1.7	8.5	208.97	22994	315.92	-0.1
315.42	2.1	8.5	209.02	22979	316.02	-0.1
315.52	2.3	8.5	209.07	24096	316.12	-0.1
315.62	2.1	8.5	209.12	24836	316.22	-0.1
315.72	1.8	8.5	209.17	24360	316.32	-0.2
315.82	1.9	8.5	209.22	24496	316.42	0.1
315.92	2	8.5	209.27	24224	316.52	0
316.02	1.7	8.5	209.32	24012	316.62	-0.1
316.12	1.8	8.5	209.37	23086	316.72	-0.1
316.22	1.5	8.5	209.42	23766	316.82	0
316.32	1.5	8.5	209.47	23780	316.92	0.1
316.42	1.7	8.5	209.52	23355	317.02	0.1
316.52	1.8	8.5	209.57	23452	317.12	0.2
316.62	1.8	8.5	209.62	23333	317.22	0.1
316.72	1.6	8.5	209.67	23640	317.32	0.1
316.82	1.6	8.5	209.72	23356	317.42	0.1
316.92	1.6	8.5	209.77	23641	317.52	0
317.02	1.4	8.5	209.82	24000	317.62	0.1
317.12	1.5	8.5	209.87	23700	317.72	0
317.22	1.5	8.5	209.92	23874	317.82	0
317.32	1.7	8.5	209.97	22626	317.92	-0.1
317.42	1.5	8.5	210.02	23524	318.02	-0.1
317.52	1.6	8.5	210.07	23640	318.12	0
317.62	1.5	8.5	210.12	23253	318.22	0
317.72	1.2	8.5	210.17	24049	318.32	-0.1
317.82	1.1	8.5	210.22	23402	318.42	-0.1
317.92	1	8.5	210.27	22980	318.52	-0.1
318.02	1	8.5	210.32	23330	318.62	0.1
318.12	1	8.5	210.37	23680	318.72	0.2
318.22	1.2	8.5	210.42	24476	318.82	0.1
318.32	1.4	8.5	210.47	23753	318.92	0.1
318.42	1.3	8.5	210.52	23539	319.02	0
318.52	1.3	8.5	210.57	24043	319.12	0.1
318.62	1.3	8.5	210.62	23673	319.22	0
318.72	1.1	8.5	210.67	24615	319.32	0
318.82	1.2	8.5	210.72	23409	319.42	0
318.92	1.5	8.5	210.77	24132	319.52	0
319.02	1.4	8.5	210.82	24116	319.62	0
319.12	1.2	8.5	210.87	23759	319.72	-0.1
319.22	1	8.5	210.92	23500	319.82	0
319.32	1.1	8.5	210.97	24100	319.92	0.1
319.42	1.1	8.5	211.02	24720	320.02	0.1
319.52	1	8.5	211.07	23737	320.12	0.1
319.62	0.9	8.5	211.12	24161	320.22	0.1
319.72	1.1	8.5	211.17	23962	320.32	0
319.82	0.9	8.5	211.22	23371	320.42	0.1
319.92	1.2	8.5	211.27	22583	320.52	0
320.02	1.7	8.5	211.32	23270	320.62	0
320.12	1.7	8.5	211.37	23063	320.72	0
320.22	1.5	8.5	211.42	23025	320.82	0
320.32	1.4	8.5	211.47	22972	320.92	-0.1
320.42	1.2	8.5	211.52	22816	321.02	-0.1

320.52	1.1	8.5	211.57	22974	321.12	0
320.62	1.1	8.5	211.62	23051	321.22	0.2
320.72	0.8	8.5	211.67	22908	321.32	0.2
320.82	0.7	8.5	211.72	22943	321.42	0.2
320.92	1.1	8.5	211.78	22852	321.52	0.1
321.02	1.3	8.5	211.83	23041	321.62	0.1
321.12	1.4	8.5	211.88	23529	321.72	0.1
321.22	1.4	8.5	211.93	24207	321.82	0
321.32	1.5	8.5	211.98	23050	321.92	0
321.42	1.5	8.5	212.03	23794	322.02	-0.1
321.52	1.4	8.5	212.08	23750	322.12	-0.1
321.62	1.5	8.5	212.13	24000	322.22	0
321.72	1.7	8.5	212.18	23279	322.32	-0.1
321.82	1.8	8.5	212.23	23273	322.42	-0.1
321.93	1.7	8.5	212.28	23145	322.53	-0.2
322.03	1.2	8.5	212.33	23292	322.63	-0.1
322.13	0.9	8.5	212.38	22613	322.73	0
322.23	1.1	8.5	212.43	23446	322.83	0.1
322.33	1.7	8.5	212.48	23439	322.93	0
322.43	2.1	8.5	212.53	23280	323.03	0.1
322.53	2.2	8.5	212.58	23175	323.13	0.1
322.63	2.2	8.5	212.63	23312	323.23	0.1
322.73	2.2	8.5	212.68	23042	323.33	0
322.83	2.1	8.5	212.73	23393	323.43	0
322.94	2	8.5	212.78	23502	323.54	0
323.04	2	8.5	212.83	23288	323.64	0
323.14	2.1	8.5	212.88	23103	323.74	0
323.24	2.2	8.5	212.93	23515	323.84	0
323.34	2.2	8.5	212.98	23871	323.94	-0.1
323.44	1.9	8.5	213.03	23584	324.04	0
323.54	2	8.5	213.08	24382	324.14	-0.1
323.64	1.7	8.5	213.13	24323	324.24	0
323.74	1.5	8.5	213.18	23632	324.34	0.1
323.84	1.7	8.5	213.23	24248	324.44	0.1
323.95	1.8	8.5	213.28	23634	324.55	0.2
324.05	1.9	8.5	213.33	24504	324.65	0.1
324.15	2.2	8.5	213.38	24113	324.75	0.1
324.25	2.2	8.5	213.43	24208	324.85	0.1
324.35	2	8.5	213.48	24635	324.95	0.1
324.45	2	8.5	213.53	23557	325.05	0
324.55	2	8.5	213.58	24395	325.15	0
324.65	1.8	8.5	213.63	23861	325.25	-0.1
324.75	1.7	8.5	213.68	24336	325.35	0
324.85	1.7	8.5	213.74	23792	325.45	0
324.96	1.7	8.5	213.79	24279	325.56	0
325.06	1.6	8.5	213.84	23800	325.66	-0.1
325.16	1.8	8.5	213.89	24155	325.76	0.1
325.26	1.7	8.5	213.94	23504	325.86	0.1
325.36	1.7	8.5	213.99	23340	325.96	0.2
325.46	1.8	8.5	214.04	23644	326.06	0.1
325.56	1.7	8.5	214.09	23782	326.16	0
325.66	1.5	8.5	214.14	24362	326.26	0.1
325.76	1.3	8.5	214.19	24072	326.36	0
325.86	1.5	8.5	214.24	24259	326.46	0
325.97	1.8	8.5	214.29	24238	326.57	0
326.07	1.8	8.5	214.34	23924	326.67	0

326.17	1.8	8.5	214.39	24313	326.77	0
326.27	1.9	8.5	214.44	23615	326.87	-0.2
326.37	2	8.5	214.49	24281	326.97	-0.1
326.47	2.4	8.5	214.54	24688	327.07	0.1
326.57	2.8	8.5	214.59	25115	327.17	0.2
326.67	2.7	8.5	214.64	23762	327.27	0.2
326.77	2.9	8.5	214.69	24772	327.37	0
326.88	3.1	8.5	214.74	24529	327.48	0.1
326.98	2.9	8.5	214.79	24497	327.58	0.1
327.08	3.1	8.5	214.84	24225	327.68	0.1
327.18	2.9	8.5	214.89	24023	327.78	0
327.28	2.2	8.5	214.94	24609	327.88	0
327.38	1.7	8.5	214.99	24082	327.98	0
327.48	1.8	8.5	215.04	25094	328.08	0
327.58	2	8.5	215.09	24769	328.18	0
327.68	3.2	8.5	215.14	23931	328.28	0
327.78	3.4	8.5	215.19	24788	328.38	0
327.89	3.4	8.5	215.24	25083	328.49	0
327.99	3.2	8.5	215.29	25152	328.59	0
328.09	3	8.5	215.34	24700	328.69	0
328.19	3.1	8.5	215.39	24423	328.79	0.1
328.29	3.1	8.5	215.44	24654	328.89	0.3
328.39	2.8	8.5	215.49	24403	328.99	0.2
328.49	2.8	8.5	215.54	24295	329.09	0.1
328.59	2.9	8.5	215.59	24470	329.19	0.2
328.69	2.8	8.5	215.64	24730	329.29	0.2
328.79	2.8	8.5	215.69	24910	329.39	0.2
328.9	2.3	8.5	215.75	24669	329.5	0.1
329	2.1	8.5	215.8	25059	329.6	0
329.1	2.2	8.5	215.85	24030	329.7	0
329.2	2.2	8.5	215.9	24621	329.8	0.2
329.3	2.3	8.5	215.95	24000	329.9	0.3
329.4	2.4	8.5	216	24783	330	0.5
329.5	2.5	8.5	216.05	24733	330.1	0.4
329.6	3.1	8.5	216.1	24241	330.2	0
329.7	3.7	8.5	216.15	24666	330.3	0.3
329.8	3.5	8.5	216.2	24327	330.4	0.4
329.91	3.5	8.5	216.25	24447	330.51	0.3
330.01	4	8.5	216.3	24241	330.61	0.3
330.11	5.3	8.5	216.35	24829	330.71	0.5
330.21	5.7	8.5	216.4	23725	330.81	0.2
330.31	5.6	8.5	216.45	24639	330.91	0
330.41	3.6	8.5	216.5	24653	331.01	0
330.51	3.3	8.5	216.55	23901	331.11	0.1
330.61	4.5	8.5	216.6	24679	331.21	0
330.71	5.5	8.5	216.65	24398	331.31	0
330.81	5.7	8.5	216.7	24165	331.41	-0.1
330.92	4.7	8.5	216.75	24373	331.52	0.1
331.02	4	8.5	216.8	24344	331.62	0.1
331.12	5.3	8.5	216.85	24376	331.72	0.1
331.22	6.4	8.5	216.9	24663	331.82	0.1
331.32	5.9	8.5	216.95	23696	331.92	0
331.42	6.2	8.5	217	24356	332.02	0
331.52	6.2	8.5	217.05	24017	332.12	0
331.62	5.6	8.5	217.1	23575	332.22	0
331.72	5.7	8.5	217.15	24141	332.32	0

331.82	6.3	8.5	217.2	23881	332.42	0
331.93	6.7	8.5	217.25	24287	332.53	0
332.03	5.4	8.5	217.3	24595	332.63	-0.2
332.13	5.8	8.5	217.35	24084	332.73	-0.1
332.23	6.1	8.5	217.4	24160	332.83	0
332.33	6.3	8.5	217.45	24515	332.93	0.1
332.43	6.5	8.5	217.5	24181	333.03	0.1
332.53	7	8.5	217.55	24543	333.13	0.1
332.63	7.1	8.5	217.6	24405	333.23	0.1
332.73	6.6	8.5	217.65	24296	333.33	0.1
332.83	5.4	8.5	217.71	24370	333.43	0
332.94	5.3	8.5	217.76	24135	333.54	0.1
333.04	5.3	8.5	217.81	24159	333.64	0
333.14	4.8	8.5	217.86	23858	333.74	0
333.24	4.7	8.5	217.91	23769	333.84	0
333.34	5	8.5	217.96	23884	333.94	0
333.44	4.6	8.5	218.01	23649	334.04	0.1
333.54	4.4	8.5	218.06	24281	334.14	0.2
333.64	4.2	8.5	218.11	23802	334.24	0.2
333.74	4.8	8.5	218.16	23943	334.34	0.1
333.84	5.5	8.5	218.21	24478	334.44	0.1
333.95	4.9	8.5	218.26	23748	334.55	0.1
334.05	4.3	8.5	218.31	24597	334.65	0.1
334.15	4	8.5	218.36	24627	334.75	0
334.25	4.1	8.5	218.41	24768	334.85	0.2
334.35	3.8	8.5	218.46	24404	334.95	0.1
334.45	3.3	8.5	218.51	23757	335.05	0.1
334.55	2.9	8.5	218.56	24322	335.15	0
334.65	3.5	8.5	218.61	24420	335.25	0.1
334.75	3.4	8.5	218.66	24202	335.35	0.3
334.85	1.6	8.5	218.71	23941	335.45	0.3
334.96	1.8	8.5	218.76	24271	335.56	0.2
335.06	2	8.5	218.81	24308	335.66	0.2
335.16	1.8	8.5	218.86	24133	335.76	0.2
335.26	1.9	8.5	218.91	24071	335.86	0.2
335.36	1.9	8.5	218.96	23538	335.96	0.1
335.46	2.1	8.5	219.01	23595	336.06	0.1
335.56	1.8	8.5	219.06	24149	336.16	0.1
335.66	1.8	8.5	219.11	24244	336.26	0.1
335.76	1.8	8.5	219.16	24205	336.36	0.1
335.86	1.6	8.5	219.21	23906	336.46	0.1
335.97	1.3	8.5	219.26	24327	336.57	0.2
336.07	1.5	8.5	219.31	24365	336.67	0.3
336.17	1.5	8.5	219.36	24398	336.77	1.4
336.27	1.3	8.5	219.41	23579	336.87	2.7
336.37	1.1	8.5	219.46	23765	336.97	2.4
336.47	1.1	8.5	219.51	23255	337.07	1.3
336.57	1.1	8.5	219.56	23693	337.17	0.9
336.67	1.1	8.5	219.61	23650	337.27	0.5
336.77	3.8	8.5	219.66	24763	337.37	0.2
336.88	4.3	8.5	219.72	23634	337.48	0.1
336.98	4	8.5	219.77	24363	337.58	0.1
337.08	2.1	8.5	219.82	24302	337.68	0.1
337.18	1.2	8.5	219.87	23941	337.78	0.2
337.28	1.1	8.5	219.92	24116	337.88	0.3
337.38	1.1	8.5	219.97	24334	337.98	0.3

337.48	1.1	8.5	220.02	24663	338.08	0.3
337.58	1.4	8.5	220.07	23984	338.18	0.3
337.68	1.2	8.5	220.12	23693	338.28	0.2
337.78	1.1	8.5	220.17	24119	338.38	0.1
337.89	1	8.5	220.22	23745	338.49	0.1
337.99	1.1	8.5	220.27	23550	338.59	0.1
338.09	1	8.5	220.32	24202	338.69	0.1
338.19	1	8.5	220.37	23322	338.79	0.1
338.29	1	8.5	220.42	24358	338.89	0.1
338.39	1	8.5	220.47	24234	338.99	0.1
338.49	1	8.5	220.52	23850	339.09	0.2
338.59	1.1	8.5	220.57	23440	339.19	0.3
338.69	1.1	8.5	220.62	24445	339.29	0.2
338.79	1	8.5	220.67	24566	339.39	0.3
338.9	1.1	8.5	220.72	23477	339.5	0.7
339	1.2	8.5	220.77	25294	339.6	2.4
339.1	1.1	8.5	220.82	24516	339.7	10.4
339.2	1.2	8.5	220.87	23198	339.8	5.7
339.3	1.3	8.5	220.92	24537	339.9	1.1
339.4	1.2	8.5	220.97	24431	340	0.4
339.5	0.9	8.5	221.02	24267	340.1	0.2
339.6	0.8	8.5	221.07	24359	340.2	0.1
339.7	0.9	8.5	221.12	23838	340.3	0.2
339.8	0.2	8.5	221.17	24226	340.4	0.4
339.91	0.4	8.5	221.22	24108	340.51	0.9
340.01	0.7	8.5	221.27	23269	340.61	2
340.11	0.7	8.5	221.32	23956	340.71	1.3
340.21	0.6	8.5	221.37	24092	340.81	1.1
340.31	0.6	8.5	221.42	24054	340.91	0.4
340.41	0.5	8.5	221.47	23864	341.01	0.2
340.51	0.6	8.5	221.52	24300	341.11	0.2
340.61	2	8.5	221.57	23711	341.21	0.1
340.71	2.2	8.5	221.62	24161	341.31	0.1
340.81	1.1	8.5	221.67	24134	341.41	0.2
340.92	1.1	8.5	221.73	24109	341.52	0.6
341.02	1.1	8.5	221.77	24424	341.62	0.2
341.12	0.9	8.5	221.82	24184	341.72	0.2
341.22	0.9	8.5	221.87	24843	341.82	0.2
341.32	0.8	8.5	221.92	24464	341.92	0.3
341.42	0.8	8.5	221.97	23918	342.02	0.2
341.52	1.1	8.5	222.02	24335	342.12	0.2
341.62	1.4	8.5	222.07	23625	342.22	0.2
341.72	0.9	8.5	222.12	23662	342.32	0.2
341.82	0.9	8.5	222.17	24552	342.42	0.6
341.92	1.2	8.5	222.22	24220	342.52	0.4
342.02	1.5	8.5	222.27	24125	342.62	0.2
342.12	1.3	8.5	222.32	24028	342.72	0.1
342.22	1.3	8.5	222.37	24131	342.82	0
342.32	1.4	8.5	222.42	24194	342.92	0
342.42	1.3	8.5	222.47	23571	343.02	0.2
342.52	0.7	8.5	222.52	24117	343.12	0.2
342.62	0.7	8.5	222.57	23871	343.22	0.2
342.72	0.9	8.5	222.62	24194	343.32	0.2
342.82	1	8.5	222.67	23628	343.42	0.2
342.92	0.9	8.5	222.72	23797	343.52	0.3
343.02	0.9	8.5	222.77	24757	343.62	0.3

343.12	1	8.5	222.82	23927	343.72	0.4
343.22	1.3	8.5	222.87	23921	343.82	0.9
343.32	1.5	8.5	222.92	23709	343.92	1.8
343.42	1.2	8.5	222.97	23892	344.02	3.9
343.52	1.1	8.5	223.02	23876	344.12	16.2
343.62	0.7	8.5	223.07	23702	344.22	21.9
343.72	0.6	8.5	223.12	23736	344.32	10.6
343.82	0.4	8.5	223.17	24558	344.42	5.6
343.92	0.2	8.5	223.22	23284	344.52	5.6
344.02	0.1	8.5	223.27	23861	344.62	6.3
344.12	0.8	8.5	223.32	24640	344.72	6.3
344.22	5.4	8.5	223.37	23704	344.82	5.2
344.32	7.8	8.5	223.42	23831	344.92	4.7
344.42	9.6	8.5	223.47	23944	345.02	4.4
344.52	8.7	8.5	223.52	23565	345.12	5.6
344.62	6.7	8.5	223.57	23825	345.22	6.9
344.72	5.4	8.5	223.62	23986	345.32	5.5
344.82	4	8.5	223.67	24163	345.42	3.6
344.92	2.6	8.5	223.72	23541	345.52	3.3
345.02	1.6	8.5	223.77	23466	345.62	2.7
345.12	1.3	8.5	223.82	24278	345.72	1.4
345.22	1.2	8.5	223.87	23919	345.82	0.6
345.32	1.2	8.5	223.92	24259	345.92	0.5
345.42	1.6	8.5	223.97	24839	346.02	0.3
345.52	1.3	8.5	224.02	24952	346.12	0.3
345.62	1.1	8.5	224.07	25100	346.22	0.2
345.72	1.3	8.5	224.12	23994	346.32	0.3
345.82	1.6	8.5	224.17	24189	346.42	0.3
345.92	1.2	8.5	224.22	24215	346.52	0.3
346.02	1.1	8.5	224.27	24148	346.62	0.2
346.12	1	8.5	224.32	24040	346.72	0.3
346.22	0.9	8.5	224.37	24198	346.82	0.2
346.32	1.8	8.5	224.42	23986	346.92	0.4
346.42	1.4	8.5	224.47	24291	347.02	0.3
346.52	1.1	8.5	224.52	24333	347.12	0.3
346.62	1.2	8.5	224.57	24211	347.22	0.3
346.72	1.5	8.5	224.62	23262	347.32	0.2
346.82	1.9	8.5	224.67	23981	347.42	0.2
346.92	1.4	8.5	224.72	23572	347.52	0.3
347.02	1.4	8.5	224.77	23411	347.62	0.6
347.12	1.8	8.5	224.82	23553	347.72	0.7
347.22	1.9	8.5	224.87	24036	347.82	0.5
347.32	1.9	8.5	224.92	23863	347.92	0.5
347.42	1.5	8.5	224.97	23875	348.02	0.1
347.52	1.3	8.5	225.02	23616	348.12	0.1
347.62	1.3	8.5	225.07	24086	348.22	0.2
347.72	1.5	8.5	225.12	23183	348.32	0.3
347.82	1.7	8.5	225.17	23145	348.42	0.4
347.92	1.3	8.5	225.22	23812	348.52	0.6
348.02	1.5	8.5	225.27	23523	348.62	0.6
348.12	1.2	8.5	225.32	23608	348.72	0.4
348.22	1.7	8.5	225.37	23379	348.82	0.3
348.32	1.7	8.5	225.42	24047	348.92	0.2
348.42	1.7	8.5	225.47	24232	349.02	0.2
348.52	1.5	8.5	225.52	24649	349.12	0.2
348.62	1.1	8.5	225.57	24305	349.22	0.2

348.72	1.2	8.5	225.62	23691	349.32	0.3
348.82	1.4	8.5	225.67	24104	349.42	0.5
348.92	1.6	8.5	225.72	23018	349.52	0.6
349.02	1.6	8.5	225.77	23691	349.62	0.5
349.12	1.6	8.5	225.82	24098	349.72	0.4
349.22	1.5	8.5	225.87	24725	349.82	0.4
349.32	1.4	8.5	225.92	23863	349.92	0.6
349.42	1.4	8.5	225.97	23955	350.02	0.7
349.52	1.5	8.5	226.02	24775	350.12	0.9
349.62	1.5	8.5	226.07	24285	350.22	0.8
349.72	1.3	8.5	226.12	24620	350.32	1
349.82	1.3	8.5	226.17	24437	350.42	1.1
349.92	1.3	8.5	226.22	23813	350.52	1.3
350.02	1.2	6.75	226.27	24130	350.62	1.6
350.12	1.4	6.75	226.32	23825	350.72	2.2
350.22	1.4	6.75	226.37	23594	350.82	2.3
350.32	1.6	6.75	226.42	23943	350.92	1.8
350.42	1.7	6.75	226.47	23988	351.02	1.1
350.52	2.1	6.75	226.52	24587	351.12	0.7
350.62	2.4	6.75	226.57	24068	351.22	0.2
350.72	2.5	6.75	226.62	24000	351.32	0.2
350.82	2.3	6.75	226.67	24558	351.42	0.2
350.92	2.2	6.75	226.72	24983	351.52	0.3
351.02	2.7	6.75	226.77	24236	351.62	0.7
351.12	3.4	6.75	226.82	24900	351.72	0.7
351.22	3.7	6.75	226.87	24326	351.82	0.6
351.32	3.1	6.75	226.92	23586	351.92	0.6
351.42	2.3	6.75	226.97	23952	352.02	0.4
351.52	2.4	6.75	227.02	23364	352.12	0.2
351.62	2.3	6.75	227.07	24434	352.22	0.2
351.72	2.1	6.75	227.12	23863	352.32	0.1
351.82	2.2	6.75	227.17	23886	352.42	0.1
351.93	2.1	6.75	227.22	23212	352.53	0.1
352.03	1.9	6.75	227.27	23808	352.63	0.1
352.13	1.6	6.75	227.32	25151	352.73	0
352.23	0.9	6.75	227.37	25554	352.83	0
352.33	0.4	6.75	227.42	25150	352.93	0
352.43	0.3	6.75	227.47	24750	353.03	0.2
352.53	0.2	6.75	227.52	24121	353.13	0.2
352.63	0.2	6.75	227.57	24471	353.23	0.2
352.73	0.5	6.75	227.62	23825	353.33	0.2
352.83	0.7	6.75	227.67	23901	353.43	0.2
352.94	0.6	6.75	227.72	23929	353.54	0.1
353.04	0.5	6.75	227.77	23955	353.64	0.1
353.14	0.2	6.75	227.82	24140	353.74	0
353.24	0.2	6.75	227.87	24459	353.84	0
353.34	0.4	6.75	227.92	24492	353.94	0
353.44	0.7	6.75	227.97	24174	354.04	0
353.54	0.9	6.75	228.02	23658	354.14	0
353.64	0.7	6.75	228.07	24121	354.24	0
353.74	0.5	6.75	228.12	23962	354.34	0.1
353.84	0.4	6.75	228.17	24219	354.44	0.2
353.95	0.4	6.75	228.22	24321	354.55	0.2
354.05	0.4	6.75	228.27	24241	354.65	0.2
354.15	0.3	6.75	228.32	23834	354.75	0.1
354.25	0.3	6.75	228.37	23947	354.85	0.1

354.35	0.3	6.75	228.42	23281	354.95	0.1
354.45	0.2	6.75	228.47	23896	355.05	0
354.55	0.2	6.75	228.52	24211	355.15	0
354.65	0.2	6.75	228.57	23938	355.25	-0.1
354.75	0.3	6.75	228.62	23898	355.35	-0.1
354.85	0.2	6.75	228.67	24169	355.45	-0.1
354.96	0.2	6.75	228.72	23627	355.56	0.1
355.06	0.5	6.75	228.77	24005	355.66	0.2
355.16	0.5	6.75	228.82	23621	355.76	0.1
355.26	0.4	6.75	228.87	23857	355.86	0.1
355.36	0.2	6.75	228.92	23650	355.96	0.1
355.46	0.1	6.75	228.97	23046	356.06	0
355.56	0.2	6.75	229.02	23982	356.16	0.1
355.66	0.2	6.75	229.07	24132	356.26	0.1
355.76	0.3	6.75	229.12	23888	356.36	0.2
355.86	0.3	6.5	229.17	23993	356.46	0.2
355.97	0.3	6.5	229.22	24987	356.57	0.3
356.07	0.4	6.5	229.27	23761	356.67	0.2
356.17	0.3	6.5	229.32	23143	356.77	0.3
356.27	0.3	6.5	229.37	23561	356.87	0.6
356.37	0.3	6.5	229.42	24831	356.97	0.8
356.47	0.3	6.5	229.47	23775	357.07	0.5
356.57	0.3	6.5	229.52	24354	357.17	0.4
356.67	0.1	6.5	229.57	23326	357.27	0.6
356.77	0.1	6.5	229.62	23549	357.37	0.8
356.88	0.1	6.5	229.67	23574	357.48	0.4
356.98	0.2	6.5	229.72	23133	357.58	0.1
357.08	0.2	6.5	229.77	23500	357.68	0
357.18	0.3	6.5	229.82	23840	357.78	0.1
357.28	0.6	6.5	229.87	23514	357.88	0.1
357.38	0.4	6.5	229.92	24655	357.98	0.2
357.48	0.3	6.5	229.97	23912	358.08	0.2
357.58	0.3	6.5	230.02	23347	358.18	0.2
357.68	0.4	6.5	230.07	24552	358.28	0.3
357.78	0.5	6.5	230.12	23922	358.38	0.3
357.89	0.5	6.5	230.17	23581	358.49	0.2
357.99	0.4	6.5	230.22	23237	358.59	0.2
358.09	0.4	6.5	230.27	24031	358.69	0.1
358.19	0.3	6.5	230.32	23616	358.79	0.2
358.29	0.3	6.5	230.37	24144	358.89	0.2
358.39	0.3	6.5	230.42	23937	358.99	0.2
358.49	0.3	6.5	230.47	23230	359.09	0.3
358.59	0.4	6.5	230.52	23333	359.19	0.2
358.69	0.4	6.5	230.57	24155	359.29	0.2
358.79	0.5	6.5	230.62	23598	359.39	0.1
358.9	0.3	6.5	230.67	23463	359.5	0.1
359	0.2	6.5	230.72	23962	359.6	0
359.1	0.2	11	230.77	24044	359.7	0.1
359.2	0.1	11	230.82	24195	359.8	0
359.3	0.1	11	230.87	23530	359.9	0
359.4	-0.1	11	230.92	23691	360	0.1
359.5	-0.2	11	230.97	23616	360.1	0.2
359.6	-0.1	11	231.02	23376	360.2	0.1
359.7	-0.1	11	231.07	23390	360.3	0.1
359.8	-0.1	11	231.12	23754	360.4	0.2
359.91	-0.1	11	231.17	23349	360.51	0.1

360.01	0	11	231.22	23911	360.61	0.1
360.11	0.2	11	231.27	23894	360.71	0
360.21	0.3	11	231.32	23578	360.81	0
360.31	0.4	11	231.37	23653	360.91	0
360.41	0.3	11	231.42	24069	361.01	0.1
360.51	0.2	11	231.47	23901	361.11	0
360.61	0.1	11	231.52	23838	361.21	0.1
360.71	0	11	231.57	24528	361.31	0.2
360.81	0.1	11	231.62	24146	361.41	0.2
360.92	0.1	11	231.67	23897	361.52	0.1
361.02	0.1	11	231.72	23781	361.62	0.1
361.12	0.2	11	231.77	23646	361.72	0
361.22	0.3	11	231.82	23588	361.82	0
361.32	0.3	11	231.87	23690	361.92	0.1
361.42	0	11	231.92	23798	362.02	0
361.52	0	11	231.97	24362	362.12	-0.1
361.62	0	11	232.02	23538	362.22	0
361.72	0.1	11	232.07	23737	362.32	0.1
361.82	0.3	11	232.12	23837	362.42	0.1
361.92	0.2	11	232.17	24422	362.52	0.1
362.02	0.2	11	232.22	23583	362.62	0.1
362.12	0.1	11	232.27	24233	362.72	0.1
362.22	0.1	11	232.32	23836	362.82	0.1
362.32	0.3	11	232.37	23573	362.92	0
362.42	0.4	11	232.42	24273	363.02	-0.1
362.52	0.4	11	232.47	23736	363.12	-0.1
362.62	0.1	11	232.52	23897	363.22	0
362.72	0.2	11	232.57	23881	363.32	0.1
362.82	0.1	11	232.62	24066	363.42	0.1
362.92	0	11	232.67	23808	363.52	0.1
363.02	0	11	232.72	23831	363.62	0.1
363.12	0	11	232.77	23682	363.72	0.1
363.22	0	11	232.82	24017	363.82	0.1
363.32	0.1	11	232.87	24432	363.92	0
363.42	0.3	11	232.92	24042	364.02	0
363.52	0.1	11	232.97	24271	364.12	-0.1
363.62	0	11	233.02	24295	364.22	0
363.72	0.1	11	233.07	23874	364.32	-0.1
363.82	0.1	11	233.12	23737	364.42	0
363.92	0	11	233.17	24131	364.52	0.1
364.02	0	11	233.22	24507	364.62	0.2
364.12	0	11	233.27	24510	364.72	0.1
364.22	0	11	233.32	24421	364.82	0.1
364.32	0	11	233.37	23940	364.92	0
364.42	0.3	11	233.42	23643	365.02	0.1
364.52	0.6	11	233.47	24286	365.12	0
364.62	0.4	11	233.52	23742	365.22	0
364.72	0.3	11	233.57	23576	365.32	0
364.82	0.2	11	233.62	23638	365.42	0
364.92	0.1	11	233.67	23659	365.52	0.2
365.02	0	11	233.72	23983	365.62	0.2
365.12	0	11	233.77	24071	365.72	0.2
365.22	0	11	233.82	23597	365.82	0.2
365.32	0.1	11	233.87	24516	365.92	0.1
365.42	0.2	11	233.92	24505	366.02	0.1
365.52	0.1	11	233.97	24613	366.12	0

365.62	0.2	11	234.02	23864	366.22	-0.1
365.72	0.1	11	234.07	23857	366.32	-0.1
365.82	0.3	11	234.12	23451	366.42	-0.1
365.92	0.2	11	234.17	24230	366.52	-0.1
366.02	0	11	234.22	24486	366.62	0
366.12	0.1	11	234.27	24130	366.72	0.1
366.22	0.2	11	234.32	23703	366.82	0.2
366.32	0.3	11	234.37	24005	366.92	0
366.42	0.4	11	234.42	23584	367.02	0
366.52	0.7	11	234.47	24405	367.12	0
366.62	0.7	11	234.52	23887	367.22	0
366.72	1.1	11	234.57	24758	367.32	0
366.82	0.6	11	234.62	23989	367.42	-0.1
366.92	0.8	11	234.67	23142	367.52	-0.1
367.02	0.6	11	234.72	24049	367.62	-0.1
367.12	0.4	11	234.77	23810	367.72	0.1
367.22	0.5	11	234.82	23936	367.82	0.2
367.32	0.5	11	234.87	24155	367.92	0.1
367.42	0.5	11	234.92	23610	368.02	0.1
367.52	0.6	11	234.97	23409	368.12	0.1
367.62	0.6	11	235.02	23897	368.22	0.1
367.72	0.5	11	235.07	24064	368.32	0.1
367.82	0.4	11	235.12	23530	368.42	0
367.92	0.4	11	235.17	23545	368.52	0
368.02	0.4	11	235.22	24389	368.62	-0.1
368.12	0.4	11	235.27	23522	368.72	0
368.22	0.3	11	235.32	24075	368.82	0
368.32	0.2	11	235.37	23774	368.92	0.1
368.42	0.3	11	235.42	23745	369.02	0.1
368.52	0.3	11	235.47	23783	369.12	0.1
368.62	0.2	11	235.52	23609	369.22	0.1
368.72	0.1	11	235.57	23876	369.32	0.1
368.82	0.3	11	235.62	24032	369.42	0.1
368.92	0.4	11	235.67	24085	369.52	0
369.02	0.3	11	235.72	23928	369.62	-0.1
369.12	0.2	11	235.77	23439	369.72	-0.1
369.22	0.1	11	235.82	23857	369.82	0.1
369.32	0.1	11	235.87	23962	369.92	0.1
369.42	0.2	11	235.92	24000	370.02	0.1
369.52	0.2	11	235.97	23782	370.12	0.1
369.62	0.2	11	236.02	23803	370.22	0.2
369.72	0.1	11	236.07	24084	370.32	0.1
369.82	0.2	11	236.12	24071	370.42	0.1
369.92	0.6	11	236.17	24372	370.52	0
370.02	0.3	11	236.22	23740	370.62	0
370.12	0.3	11	236.27	23552	370.72	-0.1
370.22	0.1	11	236.32	24115	370.82	0.1
370.32	0.1	11	236.37	23447	370.92	0.2
370.42	0.1	11	236.42	23880	371.02	0.2
370.52	0	11	236.47	22939	371.12	0.2
370.62	0.1	11	236.52	23758	371.22	0.1
370.72	0.1	11	236.57	23433	371.32	0.1
370.82	0.1	11	236.62	23407	371.42	0.1
370.92	0.1	11	236.67	22943	371.52	0
371.02	0	11	236.72	23568	371.62	0
371.12	0	11	236.77	23736	371.72	0

371.22	0	11	236.82	23881	371.82	0.1
371.32	0.1	11	236.87	23864	371.92	0.2
371.42	0.2	11	236.92	23824	372.02	0.2
371.53	0.2	11	236.97	23457	372.13	0.2
371.63	0.2	11	237.02	23755	372.23	0.1
371.74	0	11	237.07	23170	372.34	0
371.84	0.1	11	237.12	23242	372.44	-0.1
371.95	-0.1	11	237.17	23333	372.55	-0.1
372.05	0	11	237.22	24048	372.65	-0.1
372.16	0.1	11	237.27	23837	372.76	-0.1
372.26	0	11	237.32	23505	372.86	-0.1
372.37	0	11	237.37	23953	372.97	0.1
372.48	0.1	11	237.42	24726	373.08	0.1
372.58	0.1	11	237.47	23472	373.18	0.1
372.69	0.1	11	237.52	23860	373.29	0.2
372.79	0.1	11	237.57	23580	373.39	0.1
372.9	0.3	11	237.62	23420	373.5	0
373	0.6	11	237.67	23752	373.6	0.1
373.11	0.7	11	237.72	23741	373.71	-0.1
373.21	0.4	11	237.77	23122	373.81	-0.2
373.32	0.3	11	237.82	23447	373.92	-0.1
373.42	0.3	11	237.87	23905	374.02	0
373.53	0.4	11	237.92	23950	374.13	0.1
373.63	0.3	11	237.97	23737	374.23	0
373.74	0.2	11	238.02	23577	374.34	0.1
373.84	0.3	11	238.07	23461	374.44	0
373.95	0.6	11	238.12	23703	374.55	0
374.05	0.7	11	238.17	23488	374.65	0
374.16	0.4	11	238.22	23440	374.76	-0.1
374.26	0.3	11	238.27	23714	374.86	-0.1
374.37	0.2	11	238.32	23752	374.97	0.1
374.48	0.2	11	238.37	23825	375.08	0.1
374.58	0.1	11	238.42	23445	375.18	0.1
374.69	0	11	238.47	23818	375.29	0.1
374.79	0.1	11	238.52	23993	375.39	0
374.9	0.2	11	238.57	23589	375.5	0
375	0.4	11	238.62	23759	375.6	-0.1
375.11	0.4	11	238.67	24243	375.71	-0.1
375.21	0.3	11	238.72	24575	375.81	-0.1
375.32	0.2	11	238.77	23744	375.92	-0.1
375.42	0.1	11	238.82	23872	376.02	0.1
375.53	0.2	11	238.87	23697	376.13	0.1
375.63	0.2	11	238.92	23261	376.23	0.1
375.74	0.2	11	238.97	24301	376.34	0.1
375.84	0.1	11	239.02	23795	376.44	0.1
375.95	0	11	239.07	23383	376.55	0.1
376.05	0	11	239.12	23477	376.65	0.1
376.16	0	11	239.17	24053	376.76	0.1
376.26	0	11	239.22	23902	376.86	0.1
376.37	0	11	239.27	23623	376.97	0
376.48	0	11	239.32	23717	377.08	0.1
376.58	0	11	239.37	23622	377.18	0.1
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340.07	22714
340.12	22587
340.17	22333
340.22	22078
340.27	22621
340.32	22180
340.37	22694
340.42	22106
340.47	22368
340.52	22000
340.57	22510

340.62	22410
340.67	21194
340.72	21045
340.77	20236
340.82	20520
340.87	21679
340.92	21500
340.97	21909
341.02	22557
341.07	21757
341.12	21883
341.17	22265
341.22	21767
341.27	21883
341.32	22263
341.37	22459
341.42	22379
341.47	22250
341.52	21963
341.57	21732
341.62	21968
341.67	21779
341.73	21787
341.78	22363
341.83	22272
341.88	22688
341.93	22059
341.98	22695
342.03	22147
342.08	21636
342.13	22020
342.18	22354
342.23	22765
342.28	22895
342.33	22879
342.38	21881
342.43	21677
342.48	21067
342.53	21054
342.58	22016
342.63	21782
342.68	21282
342.73	22070
342.78	22180
342.83	22478
342.88	22336
342.93	21662
342.98	21904
343.03	22081
343.08	21957
343.13	22248
343.18	22604
343.23	21948
343.28	22454
343.33	22448
343.38	22005

343.43	22416
343.48	22004
343.53	21906
343.58	21744
343.63	21950
343.68	22012
343.74	21788
343.79	21511
343.84	21691
343.89	21974
343.94	22149
343.99	21668
344.04	20903
344.09	19752
344.14	18753
344.19	16700
344.24	16106
344.29	15936
344.34	16580
344.39	16702
344.44	17204
344.49	16658
344.54	17196
344.59	16806
344.64	16950
344.69	16430
344.74	17085
344.79	17027
344.84	17369
344.89	17446
344.94	17131
344.99	16951
345.04	17589
345.09	17174
345.14	17400
345.19	17269
345.24	17162
345.29	17026
345.34	17430
345.39	16806
345.44	16995
345.49	16518
345.54	16963
345.59	17024
345.64	17164
345.69	17797
345.75	18111
345.8	18011
345.85	18044
345.9	18650
345.95	19366
346	19777
346.05	19342
346.1	20157
346.15	20117
346.2	20008

346.25	20048
346.3	19574
346.35	19318
346.4	18826
346.45	18678
346.5	18484
346.55	18748
346.6	18678
346.65	18765
346.7	19245
346.75	19124
346.8	19225
346.85	19505
346.9	19232
346.95	19040
347	19768
347.05	19835
347.1	19248
347.15	19953
347.2	19312
347.25	20161
347.3	20156
347.35	19713
347.4	19947
347.45	19566
347.5	19685
347.55	19477
347.6	19865
347.65	19426
347.71	18857
347.76	19138
347.81	19206
347.86	19511
347.91	19738
347.96	19895
348.01	19762
348.06	20154
348.11	20180
348.16	20925
348.21	20090
348.26	20665
348.31	20660
348.36	20230
348.41	20137
348.46	19925
348.51	20705
348.56	20004
348.61	19737
348.66	20093
348.71	20053
348.76	20110
348.81	19934
348.86	19864
348.91	19576
348.96	20663
349.01	19738

349.06	19760
349.11	20090
349.16	19932
349.21	20270
349.26	19689
349.31	19508
349.36	19972
349.41	19477
349.46	19559
349.51	19927
349.56	19712
349.61	19994
349.66	19918
349.72	19113
349.77	18949
349.82	19291
349.87	19862
349.92	19118
349.97	19021
350.02	18713
350.07	19067
350.12	19111
350.17	18688
350.22	18538
350.27	19030
350.32	19139
350.37	17844
350.42	18949
350.47	18648
350.52	18066
350.57	18485
350.62	18120
350.67	18652
350.72	18716
350.77	18186
350.82	18261
350.87	18392
350.92	18759
350.97	18404
351.02	18404
351.07	18627
351.12	18605
351.17	18887
351.22	18543
351.27	18836
351.32	19034
351.37	18983
351.42	18946
351.47	19692
351.52	20020
351.57	19759
351.62	19950
351.67	20077
351.73	20068
351.77	20096
351.83	20565

351.88	20411
351.93	21081
351.98	21222
352.02	21156
352.08	20682
352.13	21134
352.18	21289
352.23	22136
352.27	22066
352.33	22196
352.38	23078
352.43	23240
352.48	22659
352.52	22928
352.58	23218
352.63	23546
352.68	23375
352.73	23758
352.77	23655
352.83	23360
352.88	24000
352.93	23027
352.98	23703
353.02	23675
353.08	23644
353.13	24089
353.18	23767
353.23	22951
353.27	23266
353.33	23269
353.38	23581
353.43	23252
353.48	23248
353.52	23547
353.58	23361
353.63	22915
353.68	23746
353.73	23214
353.77	23280
353.83	23371
353.88	23608
353.93	23675
353.98	23070
354.02	22673
354.08	23493
354.13	22790
354.18	23741
354.23	22649
354.27	23509
354.33	23347
354.38	23573
354.43	22802
354.48	23103
354.52	22817
354.58	22982
354.63	23382

354.68	23526
354.73	24088
354.77	23552
354.83	23140
354.88	23000
354.93	22969
354.98	23050
355.02	22207
355.08	23093
355.13	22566
355.18	23226
355.23	23015
355.27	23145
355.33	23289
355.38	23105
355.43	22931
355.48	23012
355.52	23560
355.58	23043
355.63	23602
355.68	22429
355.73	22329
355.77	21685
355.83	22885
355.88	22149
355.93	22292
355.98	22450
356.02	22891
356.08	23046
356.13	22893
356.18	22963
356.23	23143
356.27	22915
356.33	23219
356.38	23639
356.43	22879
356.48	23371
356.52	23790
356.58	23482
356.63	23059
356.68	22983
356.73	23460
356.77	22867
356.83	23365
356.88	23242
356.93	23117
356.98	23263
357.02	22581
357.08	24033
357.13	23506
357.18	22963
357.23	23337
357.27	23042
357.33	23221
357.38	23192
357.43	22833

357.48	23163
357.52	22635
357.58	23274
357.63	22932
357.68	23191
357.73	23242
357.77	22665
357.83	22323
357.88	23034
357.93	22717
357.98	23005
358.02	22431
358.08	23016
358.13	22714
358.18	22821
358.23	22708
358.27	23010
358.33	23036
358.38	22922
358.43	22269
358.48	22768
358.52	22632
358.58	22313
358.63	21558
358.68	21900
358.73	22523
358.77	22164
358.83	21950
358.88	22439
358.93	22781
358.98	23757
359.02	24618
359.08	25685
359.13	25193
359.18	24846
359.23	25989
359.27	26259
359.33	24795
359.38	26178
359.43	25337
359.48	25673
359.52	25554
359.58	24631
359.63	25578
359.68	25353
359.73	24884
359.77	25111
359.83	25467
359.88	24888
359.93	24454
359.98	24211
360.02	24425
360.08	24163
360.13	23480
360.18	23866
360.23	22982

360.27	22547
360.33	22454
360.38	22907
360.43	22653
360.48	23691
360.52	24012
360.58	23645
360.63	23246
360.68	23884
360.73	23570
360.77	24702
360.83	23615
360.88	23468
360.93	22814
360.98	21460
361.02	20800
361.08	19765
361.13	20051
361.18	20454
361.23	20461
361.27	22394
361.33	22948
361.38	24197
361.43	25011
361.48	24287
361.52	23837
361.58	23600
361.63	23416
361.68	23426
361.73	23622
361.78	23725
361.83	23690
361.88	23196
361.93	23345
361.98	23461
362.03	23684
362.08	24141
362.13	23926
362.18	24838
362.23	24716
362.28	24652
362.33	25489
362.38	24619
362.43	24538
362.48	24153
362.53	24619
362.58	24473
362.63	24421
362.68	24601
362.73	24523
362.78	25018
362.83	24347
362.88	24845
362.93	24436
362.98	25075
363.03	25384

363.08	25935
363.13	24851
363.18	25700
363.23	25109
363.28	25346
363.33	24819
363.38	24323
363.43	23556
363.48	23366
363.53	23657
363.58	24114
363.63	25171
363.68	25149
363.74	25054
363.79	25092
363.84	25018
363.89	24622
363.94	24732
363.99	24446
364.04	25022
364.09	24817
364.14	25106
364.19	24604
364.24	25034
364.29	25395
364.34	25121
364.39	24746
364.44	24843
364.49	25256
364.54	24339
364.59	24579
364.64	24563
364.69	24146
364.74	23789
364.79	24728
364.84	24891
364.89	24673
364.94	24824
364.99	24460
365.04	25055
365.09	24881
365.14	25129
365.19	24578
365.24	25179
365.29	24946
365.34	24697
365.39	24700
365.44	24512
365.49	24072
365.54	24296
365.59	24552
365.64	24909
365.69	24254
365.75	24013
365.8	23583
365.85	23703

365.9	23975
365.95	23395
366	23849
366.05	23161
366.1	23272
366.15	23690
366.2	22854
366.25	23880
366.3	22935
366.35	22239
366.4	23047
366.45	23088
366.5	21957
366.55	22049
366.6	22016
366.65	21954
366.7	22620
366.75	22613
366.8	22581
366.85	22954
366.9	21917
366.95	22489
367	22430
367.05	22374
367.1	21774
367.15	21921
367.2	21580
367.25	21587
367.3	21434
367.35	22086
367.4	22218
367.45	21979
367.5	21760
367.55	21752
367.6	22019
367.65	21509
367.71	21882
367.76	20616
367.81	21589
367.86	22091
367.91	22728
367.96	22995
368.01	23403
368.06	23247
368.11	23306
368.16	23410
368.21	23617
368.26	22881
368.31	24232
368.36	24044
368.41	23639
368.46	24040
368.51	24586
368.56	24064
368.61	24443
368.66	24657

368.71	25397
368.76	25398
368.81	25401
368.86	25113
368.91	25756
368.96	24993
369.01	25369
369.06	25655
369.11	25213
369.16	25705
369.21	25309
369.26	25360
369.31	25470
369.36	25097
369.41	25659
369.46	25304
369.51	25588
369.56	24932
369.61	24086
369.66	23987
369.72	24425
369.77	24531
369.82	24569
369.87	24551
369.92	24763
369.97	24361
370.02	24720
370.07	24779
370.12	24271
370.17	24613
370.22	24375
370.27	25076
370.32	24659
370.37	24818
370.42	24690
370.47	25082
370.52	24753
370.57	25762
370.62	26080
370.67	25280
370.72	25582
370.77	24805
370.82	25712
370.87	25076
370.92	25579
370.97	25578
371.02	24664
371.07	25276
371.12	25486
371.17	25404
371.22	25493
371.27	25574
371.32	25073
371.37	25581
371.42	25226
371.47	25805

371.52	25534
371.57	25562
371.62	25858
371.67	25420
371.73	25558
371.79	25366
371.86	26075
371.92	25113
371.98	25395
372.04	25578
372.11	25130
372.17	24884
372.23	26025
372.29	25455
372.36	25412
372.42	25205
372.48	25104
372.54	25330
372.61	24899
372.67	25407
372.73	24543
372.79	24810
372.86	24541
372.92	24944
372.98	24910
373.04	24994
373.11	24859
373.17	24942
373.23	24868
373.29	24762
373.36	25136
373.42	24708
373.48	24174
373.54	24441
373.61	24295
373.67	23646
373.73	23967
373.79	24218
373.86	23691
373.92	24227
373.98	24171
374.04	24450
374.11	24256
374.17	24777
374.23	24806
374.29	24700
374.36	24830
374.42	23854
374.48	23831
374.54	24380
374.61	24413
374.67	24853
374.73	24691
374.79	23811
374.86	24324
374.92	24711

374.98	24457
375.04	24382
375.11	24710
375.17	25033
375.23	24600
375.29	24599
375.36	24717
375.42	25025
375.48	24698
375.54	24894
375.61	24924
375.67	25475
375.73	24923
375.79	25018
375.86	25155
375.92	24824
375.98	25128
376.04	24433
376.11	24427
376.17	25000
376.23	24456
376.29	25171
376.36	25340
376.42	25261
376.48	24829
376.54	24802
376.61	24878
376.67	24546
376.73	24463
376.77	24471
376.83	24409
376.88	24406
376.93	24505

:y mV

APPENDIX 5B : OMS-LOGG

BSD59

/ x3 METHOD: SUSCEPTIBILITY mV

/ x8	DEPTH-1	DEPHT-2	VALUE
BSD59	198.82	198.92	-1.3
BSD59	198.92	199.02	0.3
BSD59	199.02	199.12	0.3
BSD59	199.12	199.22	0.4
BSD59	199.22	199.33	0.5
BSD59	199.33	199.43	0.6
BSD59	199.43	199.53	0.5
BSD59	199.53	199.63	0.4
BSD59	199.63	199.73	0.4
BSD59	199.73	199.83	0.5
BSD59	199.83	199.93	0.6
BSD59	199.93	200.03	0.6
BSD59	200.03	200.13	0.6
BSD59	200.13	200.23	0.7
BSD59	200.23	200.34	0.7
BSD59	200.34	200.44	0.6
BSD59	200.44	200.54	0.6
BSD59	200.54	200.64	0.6
BSD59	200.64	200.74	0.6
BSD59	200.74	200.84	0.6
BSD59	200.84	200.94	0.6
BSD59	200.94	201.04	0.8
BSD59	201.04	201.14	1.0
BSD59	201.14	201.24	1.2
BSD59	201.24	201.35	1.3
BSD59	201.35	201.45	1.4
BSD59	201.45	201.55	1.4
BSD59	201.55	201.65	1.2
BSD59	201.65	201.75	1.0
BSD59	201.75	201.85	0.8
BSD59	201.85	201.95	0.7
BSD59	201.95	202.05	0.7
BSD59	202.05	202.15	0.7
BSD59	202.15	202.25	0.7
BSD59	202.25	202.36	0.6
BSD59	202.36	202.46	0.6
BSD59	202.46	202.56	0.6
BSD59	202.56	202.66	0.6
BSD59	202.66	202.76	0.6
BSD59	202.76	202.86	0.6
BSD59	202.86	202.96	0.7
BSD59	202.96	203.06	0.7
BSD59	203.06	203.16	0.7
BSD59	203.16	203.26	0.7
BSD59	203.26	203.37	0.7
BSD59	203.37	203.47	0.7
BSD59	203.47	203.57	0.6
BSD59	203.57	203.67	0.6
BSD59	203.67	203.77	0.6
BSD59	203.77	203.87	0.6
BSD59	203.87	203.97	0.6
BSD59	203.97	204.07	0.6

BSD59	204.07	204.17	0.5
BSD59	204.17	204.28	0.5
BSD59	204.28	204.38	0.6
BSD59	204.38	204.48	0.6
BSD59	204.48	204.58	0.6
BSD59	204.58	204.68	0.6
BSD59	204.68	204.78	0.6
BSD59	204.78	204.88	0.6
BSD59	204.88	204.98	0.6
BSD59	204.98	205.08	0.7
BSD59	205.08	205.18	0.8
BSD59	205.18	205.29	0.9
BSD59	205.29	205.39	0.8
BSD59	205.39	205.49	0.9
BSD59	205.49	205.59	0.9
BSD59	205.59	205.69	0.9
BSD59	205.69	205.79	0.9
BSD59	205.79	205.89	0.9
BSD59	205.89	205.99	0.9
BSD59	205.99	206.09	0.9
BSD59	206.09	206.19	0.8
BSD59	206.19	206.30	0.8
BSD59	206.30	206.40	1.0
BSD59	206.40	206.50	1.2
BSD59	206.50	206.60	1.1
BSD59	206.60	206.70	1.1
BSD59	206.70	206.80	1.1
BSD59	206.80	206.90	1.0
BSD59	206.90	207.00	0.9
BSD59	207.00	207.10	1.1
BSD59	207.10	207.20	1.1
BSD59	207.20	207.31	1.0
BSD59	207.31	207.41	1.0
BSD59	207.41	207.51	1.0
BSD59	207.51	207.61	1.0
BSD59	207.61	207.71	1.1
BSD59	207.71	207.81	1.1
BSD59	207.81	207.91	1.1
BSD59	207.91	208.01	1.2
BSD59	208.01	208.11	1.2
BSD59	208.11	208.21	1.1
BSD59	208.21	208.32	1.3
BSD59	208.32	208.42	1.4
BSD59	208.42	208.52	1.6
BSD59	208.52	208.62	1.5
BSD59	208.62	208.72	1.6
BSD59	208.72	208.82	1.9
BSD59	208.82	208.92	1.8
BSD59	208.92	209.02	1.7
BSD59	209.02	209.12	1.5
BSD59	209.12	209.22	1.4
BSD59	209.22	209.32	1.2
BSD59	209.32	209.42	1.1
BSD59	209.42	209.52	1.1
BSD59	209.52	209.62	1.0
BSD59	209.62	209.72	1.0

BSD59	209.72	209.82	1.0
BSD59	209.82	209.92	0.9
BSD59	209.92	210.02	0.9
BSD59	210.02	210.12	1.0
BSD59	210.12	210.22	1.1
BSD59	210.22	210.32	1.1
BSD59	210.32	210.42	1.0
BSD59	210.42	210.52	1.0
BSD59	210.52	210.62	0.9
BSD59	210.62	210.72	0.9
BSD59	210.72	210.82	0.9
BSD59	210.82	210.92	0.8
BSD59	210.92	211.02	0.8
BSD59	211.02	211.12	0.7
BSD59	211.12	211.22	0.6
BSD59	211.22	211.32	0.7
BSD59	211.32	211.42	0.8
BSD59	211.42	211.52	0.8
BSD59	211.52	211.62	0.7
BSD59	211.62	211.72	0.8
BSD59	211.72	211.82	1.0
BSD59	211.82	211.92	1.0
BSD59	211.92	212.02	0.9
BSD59	212.02	212.12	0.8
BSD59	212.12	212.22	0.7
BSD59	212.22	212.32	0.7
BSD59	212.32	212.42	0.6
BSD59	212.42	212.52	0.6
BSD59	212.52	212.62	0.6
BSD59	212.62	212.72	0.6
BSD59	212.72	212.82	0.6
BSD59	212.82	212.92	0.6
BSD59	212.92	213.02	0.6
BSD59	213.02	213.12	0.5
BSD59	213.12	213.22	0.4
BSD59	213.22	213.32	0.4
BSD59	213.32	213.42	0.5
BSD59	213.42	213.52	0.6
BSD59	213.52	213.62	0.7
BSD59	213.62	213.72	0.7
BSD59	213.72	213.82	0.7
BSD59	213.82	213.92	0.8
BSD59	213.92	214.02	0.7
BSD59	214.02	214.12	0.7
BSD59	214.12	214.22	0.6
BSD59	214.22	214.32	0.6
BSD59	214.32	214.42	0.6
BSD59	214.42	214.52	0.7
BSD59	214.52	214.62	0.7
BSD59	214.62	214.72	0.7
BSD59	214.72	214.82	0.8
BSD59	214.82	214.92	0.9
BSD59	214.92	215.02	0.9
BSD59	215.02	215.12	1.0
BSD59	215.12	215.22	1.2
BSD59	215.22	215.32	1.3

BSD59	215.32	215.42	1.2
BSD59	215.42	215.52	1.3
BSD59	215.52	215.62	0.9
BSD59	215.62	215.72	0.6
BSD59	215.72	215.82	0.6
BSD59	215.82	215.92	0.6
BSD59	215.92	216.02	0.7
BSD59	216.02	216.12	0.9
BSD59	216.12	216.22	0.9
BSD59	216.22	216.32	0.7
BSD59	216.32	216.42	0.7
BSD59	216.42	216.52	0.7
BSD59	216.52	216.62	0.7
BSD59	216.62	216.72	0.6
BSD59	216.72	216.82	0.7
BSD59	216.82	216.92	0.8
BSD59	216.92	217.02	0.9
BSD59	217.02	217.12	0.9
BSD59	217.12	217.22	0.6
BSD59	217.22	217.32	0.7
BSD59	217.32	217.42	0.9
BSD59	217.42	217.52	1.0
BSD59	217.52	217.62	0.6
BSD59	217.62	217.72	0.6
BSD59	217.72	217.82	0.7
BSD59	217.82	217.92	0.8
BSD59	217.92	218.02	0.8
BSD59	218.02	218.12	0.8
BSD59	218.12	218.22	0.9
BSD59	218.22	218.32	1.3
BSD59	218.32	218.42	1.5
BSD59	218.42	218.52	1.4
BSD59	218.52	218.62	1.2
BSD59	218.62	218.72	1.1
BSD59	218.72	218.82	1.1
BSD59	218.82	218.92	0.9
BSD59	218.92	219.02	0.8
BSD59	219.02	219.12	0.8
BSD59	219.12	219.22	0.8
BSD59	219.22	219.32	0.9
BSD59	219.32	219.42	0.9
BSD59	219.42	219.52	1.1
BSD59	219.52	219.62	1.1
BSD59	219.62	219.72	1.0
BSD59	219.72	219.82	1.2
BSD59	219.82	219.92	1.2
BSD59	219.92	220.02	1.1
BSD59	220.02	220.12	1.1
BSD59	220.12	220.22	1.3
BSD59	220.22	220.32	1.4
BSD59	220.32	220.42	1.6
BSD59	220.42	220.52	1.6
BSD59	220.52	220.62	1.4
BSD59	220.62	220.72	1.2
BSD59	220.72	220.82	1.1
BSD59	220.82	220.92	1.2

BSD59	220.92	221.02	1.2
BSD59	221.02	221.12	1.3
BSD59	221.12	221.22	1.3
BSD59	221.22	221.32	1.3
BSD59	221.32	221.42	1.0
BSD59	221.42	221.52	1.0
BSD59	221.52	221.62	0.9
BSD59	221.62	221.72	0.9
BSD59	221.72	221.82	1.2
BSD59	221.82	221.92	1.1
BSD59	221.92	222.02	1.1
BSD59	222.02	222.12	1.1
BSD59	222.12	222.22	1.0
BSD59	222.22	222.32	1.0
BSD59	222.32	222.42	0.9
BSD59	222.42	222.52	0.8
BSD59	222.52	222.62	0.8
BSD59	222.62	222.72	0.7
BSD59	222.72	222.82	0.7
BSD59	222.82	222.92	0.8
BSD59	222.92	223.02	1.1
BSD59	223.02	223.12	0.8
BSD59	223.12	223.22	0.8
BSD59	223.22	223.32	1.0
BSD59	223.32	223.42	1.0
BSD59	223.42	223.52	0.5
BSD59	223.52	223.62	0.4
BSD59	223.62	223.72	0.4
BSD59	223.72	223.82	0.5
BSD59	223.82	223.92	0.4
BSD59	223.92	224.02	0.3
BSD59	224.02	224.12	0.3
BSD59	224.12	224.22	0.2
BSD59	224.22	224.32	0.2
BSD59	224.32	224.42	0.1
BSD59	224.42	224.52	0.1
BSD59	224.52	224.62	0.1
BSD59	224.62	224.72	0.2
BSD59	224.72	224.82	0.4
BSD59	224.82	224.92	0.5
BSD59	224.92	225.02	0.4
BSD59	225.02	225.12	0.4
BSD59	225.12	225.22	0.4
BSD59	225.22	225.32	0.3
BSD59	225.32	225.42	0.3
BSD59	225.42	225.52	0.3
BSD59	225.52	225.62	0.3
BSD59	225.62	225.72	0.2
BSD59	225.72	225.82	0.3
BSD59	225.82	225.92	0.5
BSD59	225.92	226.02	0.4
BSD59	226.02	226.12	0.3
BSD59	226.12	226.22	0.3
BSD59	226.22	226.32	0.6
BSD59	226.32	226.42	1.0
BSD59	226.42	226.52	1.1

BSD59	226.52	226.62	1.3
BSD59	226.62	226.72	1.4
BSD59	226.72	226.82	1.3
BSD59	226.82	226.92	1.4
BSD59	226.92	227.02	1.6
BSD59	227.02	227.12	1.6
BSD59	227.12	227.22	1.7
BSD59	227.22	227.32	1.6
BSD59	227.32	227.42	1.5
BSD59	227.42	227.52	1.4
BSD59	227.52	227.62	1.2
BSD59	227.62	227.72	1.1
BSD59	227.72	227.82	1.1
BSD59	227.82	227.92	1.2
BSD59	227.92	228.02	1.3
BSD59	228.02	228.12	1.2
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BSD59	228.52	228.62	1.3
BSD59	228.62	228.72	1.2
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BSD59	229.02	229.12	1.2
BSD59	229.12	229.22	1.2
BSD59	229.22	229.32	1.2
BSD59	229.32	229.42	1.3
BSD59	229.42	229.52	1.5
BSD59	229.52	229.62	1.6
BSD59	229.62	229.72	1.5
BSD59	229.72	229.82	1.4
BSD59	229.82	229.92	1.3
BSD59	229.92	230.02	1.3
BSD59	230.02	230.12	1.3
BSD59	230.12	230.22	1.3
BSD59	230.22	230.32	1.2
BSD59	230.32	230.42	1.3
BSD59	230.42	230.52	1.3
BSD59	230.52	230.62	1.4
BSD59	230.62	230.72	1.4
BSD59	230.72	230.82	1.3
BSD59	230.82	230.92	1.2
BSD59	230.92	231.02	1.3
BSD59	231.02	231.12	1.3
BSD59	231.12	231.22	1.3
BSD59	231.22	231.32	1.3
BSD59	231.32	231.42	1.3
BSD59	231.42	231.52	1.4
BSD59	231.52	231.62	1.6
BSD59	231.62	231.72	1.7
BSD59	231.72	231.82	1.6
BSD59	231.82	231.92	1.6
BSD59	231.92	232.02	1.4
BSD59	232.02	232.12	1.3

BSD59	232.12	232.22	1.2
BSD59	232.22	232.32	1.1
BSD59	232.32	232.42	1.2
BSD59	232.42	232.52	1.1
BSD59	232.52	232.62	1.0
BSD59	232.62	232.72	1.0
BSD59	232.72	232.82	1.0
BSD59	232.82	232.92	1.0
BSD59	232.92	233.02	1.2
BSD59	233.02	233.12	1.4
BSD59	233.12	233.22	1.5
BSD59	233.22	233.32	1.6
BSD59	233.32	233.42	1.5
BSD59	233.42	233.52	1.3
BSD59	233.52	233.62	1.3
BSD59	233.62	233.72	1.2
BSD59	233.72	233.82	1.2
BSD59	233.82	233.92	1.3
BSD59	233.92	234.02	1.4
BSD59	234.02	234.12	1.4
BSD59	234.12	234.22	1.4
BSD59	234.22	234.32	1.4
BSD59	234.32	234.42	1.6
BSD59	234.42	234.52	1.5
BSD59	234.52	234.62	1.2
BSD59	234.62	234.72	1.2
BSD59	234.72	234.82	1.4
BSD59	234.82	234.92	1.3
BSD59	234.92	235.02	1.0
BSD59	235.02	235.12	1.0
BSD59	235.12	235.22	1.3
BSD59	235.22	235.32	1.4
BSD59	235.32	235.42	1.5
BSD59	235.42	235.52	1.2
BSD59	235.52	235.62	1.2
BSD59	235.62	235.72	1.6
BSD59	235.72	235.82	1.8
BSD59	235.82	235.92	1.4
BSD59	235.92	236.02	1.2
BSD59	236.02	236.12	1.3
BSD59	236.12	236.22	1.6
BSD59	236.22	236.32	1.5
BSD59	236.32	236.42	1.4
BSD59	236.42	236.52	1.6
BSD59	236.52	236.62	1.8
BSD59	236.62	236.72	1.8
BSD59	236.72	236.82	1.6
BSD59	236.82	236.92	1.5
BSD59	236.92	237.02	1.7
BSD59	237.02	237.12	1.9
BSD59	237.12	237.22	1.9
BSD59	237.22	237.32	1.9
BSD59	237.32	237.42	1.8
BSD59	237.42	237.52	1.7
BSD59	237.52	237.62	1.8
BSD59	237.62	237.72	2.0

BSD59	237.72	237.82	2.5
BSD59	237.82	237.92	3.0
BSD59	237.92	238.02	3.1
BSD59	238.02	238.12	2.8
BSD59	238.12	238.22	2.4
BSD59	238.22	238.32	2.4
BSD59	238.32	238.42	2.4
BSD59	238.42	238.52	2.4
BSD59	238.52	238.62	2.4
BSD59	238.62	238.72	2.3
BSD59	238.72	238.82	1.9
BSD59	238.82	238.92	1.6
BSD59	238.92	239.02	1.8
BSD59	239.02	239.12	1.9
BSD59	239.12	239.22	2.5
BSD59	239.22	239.32	4.8
BSD59	239.32	239.42	5.5
BSD59	239.42	239.52	5.3
BSD59	239.52	239.62	4.4
BSD59	239.62	239.72	2.4
BSD59	239.72	239.82	2.4
BSD59	239.82	239.92	2.5
BSD59	239.92	240.02	2.3
BSD59	240.02	240.12	3.2
BSD59	240.12	240.22	4.3
BSD59	240.22	240.32	5.0
BSD59	240.32	240.42	5.9
BSD59	240.42	240.52	5.9
BSD59	240.52	240.62	4.5
BSD59	240.62	240.72	4.8
BSD59	240.72	240.82	5.0
BSD59	240.82	240.92	5.0
BSD59	240.92	241.02	7.2
BSD59	241.02	241.12	10.1
BSD59	241.12	241.22	11.8
BSD59	241.22	241.32	13.0
BSD59	241.32	241.42	11.4
BSD59	241.42	241.52	13.0
BSD59	241.52	241.62	14.7
BSD59	241.62	241.72	18.5
BSD59	241.72	241.82	18.8
BSD59	241.82	241.92	18.0
BSD59	241.92	242.02	19.1
BSD59	242.02	242.12	18.0
BSD59	242.12	242.22	19.5
BSD59	242.22	242.32	22.1
BSD59	242.32	242.42	24.7
BSD59	242.42	242.52	34.3
BSD59	242.52	242.62	38.9
BSD59	242.62	242.72	30.2
BSD59	242.72	242.82	30.5
BSD59	242.82	242.92	27.7
BSD59	242.92	243.02	25.2
BSD59	243.02	243.12	31.6
BSD59	243.12	243.22	36.0
BSD59	243.22	243.32	41.1

BSD59	243.32	243.42	43.6
BSD59	243.42	243.52	43.6
BSD59	243.52	243.62	42.2
BSD59	243.62	243.72	28.2
BSD59	243.72	243.82	26.4
BSD59	243.82	243.92	33.2
BSD59	243.92	244.02	35.9
BSD59	244.02	244.12	31.8
BSD59	244.12	244.22	21.6
BSD59	244.22	244.32	9.1
BSD59	244.32	244.42	6.8
BSD59	244.42	244.52	9.0
BSD59	244.52	244.62	14.9
BSD59	244.62	244.72	15.8
BSD59	244.72	244.82	11.4
BSD59	244.82	244.92	8.2
BSD59	244.92	245.02	12.5
BSD59	245.02	245.12	19.1
BSD59	245.12	245.22	17.6
BSD59	245.22	245.32	16.8
BSD59	245.32	245.42	19.9
BSD59	245.42	245.52	12.1
BSD59	245.52	245.62	8.1
BSD59	245.62	245.72	8.8
BSD59	245.72	245.82	5.1
BSD59	245.82	245.92	6.9
BSD59	245.92	246.02	17.0
BSD59	246.02	246.12	12.9
BSD59	246.12	246.22	35.0
BSD59	246.22	246.32	36.4
BSD59	246.32	246.42	37.4
BSD59	246.42	246.52	44.6
BSD59	246.52	246.62	42.4
BSD59	246.62	246.72	56.2
BSD59	246.72	246.82	62.0
BSD59	246.82	246.92	58.2
BSD59	246.92	247.02	19.8
BSD59	247.02	247.12	14.3
BSD59	247.12	247.22	30.6
BSD59	247.22	247.32	30.1
BSD59	247.32	247.42	27.3
BSD59	247.42	247.52	29.5
BSD59	247.52	247.62	30.2
BSD59	247.62	247.72	25.1
BSD59	247.72	247.82	26.7
BSD59	247.82	247.92	28.8
BSD59	247.92	248.02	26.9
BSD59	248.02	248.12	28.9
BSD59	248.12	248.22	31.8
BSD59	248.22	248.32	60.9
BSD59	248.32	248.42	137.2
BSD59	248.42	248.52	139.4
BSD59	248.52	248.62	85.5
BSD59	248.62	248.72	58.3
BSD59	248.72	248.82	69.5
BSD59	248.82	248.92	51.1

BSD59	248.92	249.02	28.2
BSD59	249.02	249.12	22.3
BSD59	249.12	249.22	21.9
BSD59	249.22	249.31	20.4
BSD59	249.31	249.41	9.0
BSD59	249.41	249.51	8.2
BSD59	249.51	249.61	9.0
BSD59	249.61	249.71	8.9
BSD59	249.71	249.81	9.2
BSD59	249.81	249.91	10.0
BSD59	249.91	250.01	11.4
BSD59	250.01	250.11	11.8
BSD59	250.11	250.21	14.1
BSD59	250.21	250.30	17.9
BSD59	250.30	250.40	15.6
BSD59	250.40	250.50	13.2
BSD59	250.50	250.60	11.3
BSD59	250.60	250.70	6.1
BSD59	250.70	250.80	-1.7
BSD59	250.80	250.90	58.2
BSD59	250.90	251.00	161.2
BSD59	251.00	251.10	58.8
BSD59	251.10	251.20	35.9
BSD59	251.20	251.29	39.8
BSD59	251.29	251.39	31.5
BSD59	251.39	251.49	26.4
BSD59	251.49	251.59	28.0
BSD59	251.59	251.69	31.4
BSD59	251.69	251.79	33.5
BSD59	251.79	251.89	30.3
BSD59	251.89	251.99	21.8
BSD59	251.99	252.09	27.6
BSD59	252.09	252.19	45.6
BSD59	252.19	252.28	56.5
BSD59	252.28	252.38	53.1
BSD59	252.38	252.48	35.8
BSD59	252.48	252.58	18.5
BSD59	252.58	252.68	12.3
BSD59	252.68	252.78	10.7
BSD59	252.78	252.88	9.7
BSD59	252.88	252.98	9.1
BSD59	252.98	253.08	8.4
BSD59	253.08	253.18	8.3
BSD59	253.18	253.27	9.4
BSD59	253.27	253.37	9.0
BSD59	253.37	253.47	10.0
BSD59	253.47	253.57	11.3
BSD59	253.57	253.67	11.2
BSD59	253.67	253.77	10.9
BSD59	253.77	253.87	11.2
BSD59	253.87	253.97	11.4
BSD59	253.97	254.07	12.0
BSD59	254.07	254.17	11.4
BSD59	254.17	254.27	10.6
BSD59	254.27	254.36	10.7
BSD59	254.36	254.46	12.2

BSD59	254.46	254.56	12.1
BSD59	254.56	254.66	11.9
BSD59	254.66	254.76	11.4
BSD59	254.76	254.86	9.7
BSD59	254.86	254.96	12.9
BSD59	254.96	255.06	18.3
BSD59	255.06	255.16	18.7
BSD59	255.16	255.26	22.0
BSD59	255.26	255.35	33.5
BSD59	255.35	255.45	35.1
BSD59	255.45	255.55	36.4
BSD59	255.55	255.65	41.3
BSD59	255.65	255.75	40.8
BSD59	255.75	255.85	42.4
BSD59	255.85	255.95	55.6
BSD59	255.95	256.05	56.2
BSD59	256.05	256.15	60.5
BSD59	256.15	256.25	61.6
BSD59	256.25	256.34	58.9
BSD59	256.34	256.44	49.1
BSD59	256.44	256.54	56.1
BSD59	256.54	256.64	62.7
BSD59	256.64	256.74	64.1
BSD59	256.74	256.84	83.7
BSD59	256.84	256.94	117.8
BSD59	256.94	257.04	127.7
BSD59	257.04	257.14	114.5
BSD59	257.14	257.24	72.4
BSD59	257.24	257.33	59.3
BSD59	257.33	257.43	65.3
BSD59	257.43	257.53	61.1
BSD59	257.53	257.63	55.0
BSD59	257.63	257.73	58.2
BSD59	257.73	257.83	92.6
BSD59	257.83	257.93	115.8
BSD59	257.93	258.03	86.7
BSD59	258.03	258.13	60.3
BSD59	258.13	258.23	40.6
BSD59	258.23	258.32	37.8
BSD59	258.32	258.42	63.6
BSD59	258.42	258.52	118.9
BSD59	258.52	258.62	139.2
BSD59	258.62	258.72	125.8
BSD59	258.72	258.82	96.5
BSD59	258.82	258.92	79.8
BSD59	258.92	259.02	131.1
BSD59	259.02	259.12	127.1
BSD59	259.12	259.22	72.2
BSD59	259.22	259.33	16.1
BSD59	259.33	259.43	-1.5
BSD59	259.43	259.53	-4.2
BSD59	259.53	259.63	-1.9
BSD59	259.63	259.73	3.8
BSD59	259.73	259.83	4.7
BSD59	259.83	259.93	4.1
BSD59	259.93	260.03	5.4

BSD59	260.03	260.13	4.8
BSD59	260.13	260.23	4.9
BSD59	260.23	260.34	5.1
BSD59	260.34	260.44	4.4
BSD59	260.44	260.54	4.9
BSD59	260.54	260.64	6.1
BSD59	260.64	260.74	6.3
BSD59	260.74	260.84	3.6
BSD59	260.84	260.94	2.9
BSD59	260.94	261.04	3.4
BSD59	261.04	261.14	3.7
BSD59	261.14	261.24	3.6
BSD59	261.24	261.35	4.3
BSD59	261.35	261.45	5.1
BSD59	261.45	261.55	6.0
BSD59	261.55	261.65	5.9
BSD59	261.65	261.75	5.0
BSD59	261.75	261.85	2.3
BSD59	261.85	261.95	1.5
BSD59	261.95	262.05	1.9
BSD59	262.05	262.15	1.4
BSD59	262.15	262.25	1.1
BSD59	262.25	262.36	1.3
BSD59	262.36	262.46	1.6
BSD59	262.46	262.56	2.6
BSD59	262.56	262.66	1.5
BSD59	262.66	262.76	1.1
BSD59	262.76	262.86	1.3
BSD59	262.86	262.96	1.4
BSD59	262.96	263.06	1.3
BSD59	263.06	263.16	1.1
BSD59	263.16	263.26	0.5
BSD59	263.26	263.37	0.2
BSD59	263.37	263.47	0.8
BSD59	263.47	263.57	1.4
BSD59	263.57	263.67	1.6
BSD59	263.67	263.77	1.6
BSD59	263.77	263.87	1.1
BSD59	263.87	263.97	1.0
BSD59	263.97	264.07	0.9
BSD59	264.07	264.17	0.9
BSD59	264.17	264.28	0.7
BSD59	264.28	264.38	0.6
BSD59	264.38	264.48	0.6
BSD59	264.48	264.58	0.6
BSD59	264.58	264.68	0.7
BSD59	264.68	264.78	0.7
BSD59	264.78	264.88	0.6
BSD59	264.88	264.98	0.6
BSD59	264.98	265.08	0.5
BSD59	265.08	265.18	0.5
BSD59	265.18	265.29	0.6
BSD59	265.29	265.39	0.5
BSD59	265.39	265.49	0.4
BSD59	265.49	265.59	0.5
BSD59	265.59	265.69	0.5

BSD59	265.69	265.79	0.6
BSD59	265.79	265.89	0.7
BSD59	265.89	265.99	0.7
BSD59	265.99	266.09	0.9
BSD59	266.09	266.19	1.0
BSD59	266.19	266.30	1.0
BSD59	266.30	266.40	0.7
BSD59	266.40	266.50	0.5
BSD59	266.50	266.60	0.4
BSD59	266.60	266.70	0.4
BSD59	266.70	266.80	0.4
BSD59	266.80	266.90	0.4
BSD59	266.90	267.00	0.4
BSD59	267.00	267.10	0.4
BSD59	267.10	267.20	0.4
BSD59	267.20	267.31	0.4
BSD59	267.31	267.41	0.6
BSD59	267.41	267.51	0.5
BSD59	267.51	267.61	0.4
BSD59	267.61	267.71	0.3
BSD59	267.71	267.81	0.2
BSD59	267.81	267.91	0.2
BSD59	267.91	268.01	0.2
BSD59	268.01	268.11	0.2
BSD59	268.11	268.21	0.2
BSD59	268.21	268.32	0.3
BSD59	268.32	268.42	0.3
BSD59	268.42	268.52	0.2
BSD59	268.52	268.62	0.2
BSD59	268.62	268.72	0.2
BSD59	268.72	268.82	0.4
BSD59	268.82	268.92	0.3
BSD59	268.92	269.02	0.2
BSD59	269.02	269.12	0.2
BSD59	269.12	269.22	0.3
BSD59	269.22	269.32	0.4
BSD59	269.32	269.42	0.5
BSD59	269.42	269.52	0.5
BSD59	269.52	269.62	0.6
BSD59	269.62	269.72	0.8
BSD59	269.72	269.82	1.0
BSD59	269.82	269.92	0.9
BSD59	269.92	270.02	0.8
BSD59	270.02	270.12	0.8
BSD59	270.12	270.22	0.7
BSD59	270.22	270.32	0.7
BSD59	270.32	270.42	0.5
BSD59	270.42	270.52	0.3
BSD59	270.52	270.62	0.2
BSD59	270.62	270.72	0.2
BSD59	270.72	270.82	0.7
BSD59	270.82	270.91	0.6
BSD59	270.91	271.01	0.2
BSD59	271.01	271.11	0.1
BSD59	271.11	271.21	0.0
BSD59	271.21	271.31	0.0

BSD59	271.31	271.41	-0.0
BSD59	271.41	271.51	0.1
BSD59	271.51	271.61	0.2
BSD59	271.61	271.71	0.3
BSD59	271.71	271.81	0.3
BSD59	271.81	271.91	0.8
BSD59	271.91	272.01	0.7
BSD59	272.01	272.11	0.4
BSD59	272.11	272.21	0.6
BSD59	272.21	272.31	1.0
BSD59	272.31	272.41	1.3
BSD59	272.41	272.51	2.0
BSD59	272.51	272.61	1.8
BSD59	272.61	272.71	1.5
BSD59	272.71	272.81	1.8
BSD59	272.81	272.91	1.8
BSD59	272.91	273.01	1.6
BSD59	273.01	273.11	1.1
BSD59	273.11	273.21	0.8
BSD59	273.21	273.31	0.7
BSD59	273.31	273.41	0.7
BSD59	273.41	273.51	0.8
BSD59	273.51	273.61	0.7
BSD59	273.61	273.71	0.6
BSD59	273.71	273.81	0.5
BSD59	273.81	273.91	0.7
BSD59	273.91	274.01	0.7
BSD59	274.01	274.11	0.7
BSD59	274.11	274.21	0.8
BSD59	274.21	274.31	0.7
BSD59	274.31	274.41	0.6
BSD59	274.41	274.51	0.7
BSD59	274.51	274.61	0.9
BSD59	274.61	274.71	1.1
BSD59	274.71	274.81	1.0
BSD59	274.81	274.91	0.8
BSD59	274.91	275.01	0.6
BSD59	275.01	275.10	0.7
BSD59	275.10	275.20	0.7
BSD59	275.20	275.30	0.8
BSD59	275.30	275.40	1.2
BSD59	275.40	275.50	1.5
BSD59	275.50	275.60	1.2
BSD59	275.60	275.70	1.0
BSD59	275.70	275.80	1.0
BSD59	275.80	275.90	1.1
BSD59	275.90	276.00	1.0
BSD59	276.00	276.10	1.0
BSD59	276.10	276.20	1.0
BSD59	276.20	276.30	0.9
BSD59	276.30	276.40	0.9
BSD59	276.40	276.50	0.9
BSD59	276.50	276.60	0.9
BSD59	276.60	276.70	0.9
BSD59	276.70	276.80	0.9
BSD59	276.80	276.90	0.9

BSD59	276.90	277.00	0.9
BSD59	277.00	277.10	0.9
BSD59	277.10	277.15	0.9

Appendix 6

Spinifex Nickel Joint Venture
Lithological codes

INTERPRETED PRIMARY LITHOLOGY

Tertiary overburden

T* - gravel, soil, colluvium

Residual weathering profile

R* - saprolitic clay, laterite, silica cap

Sediments

Ssh - shale

Sbsh - black shale

Felsic intrusives

Fg - granite

Fpg - pegmatite

Mafic lithologies

Mb - basalt

Md - dolerite

Mgb - gabbro

Mt - mafic tuff (volcanoclastic)

Ultramafic lithologies

UoC - undifferentiated olivine cumulate

UkSp(A2) - random pyroxene spinifex textured flow

UKSp(A3) - "string-beef" pyroxene spinifex textured flow

UpC - pyroxene cumulate

UKSo(A1) - flow top breccia - olivine spinifex textured flow

UKSo(A2) - random plates - olivine spinifex textured flow

UKSo(A3) - books - olivine spinifex textured flow

UoOC - olivine orthocumulate

UoOCH - olivine orthocumulate harrisitic texture

UoOMC - olivine mesocumulate

UoOAC - olivine adcumulate

XMS - massive sulphide

AZ - alteration zone

RZ - chloritic reaction zone

MZCON - mixed contact zone

Tectonic overprint

Xmy - mylonitic

Xsh - shear

Xf - fracture

METAMORPHIC MINERALOGY

Parent rocktype code

- S - sediment
- F - Felsic
- M - Mafic
- U - Ultramafic
- Metamorphic overprint

Mineralogy codes

- ac - actinolite
- am - amphibole
- an - antigorite
- bi - biotite
- c - carbonate
- ch - chlorite
- cy - chrysoprase
- cr - chrysotile
- cpx - clinopyroxene
- fs - feldspar
- gr - graphite
- lz - lizardite
- mg - magnesite
- mo - metamorphic olivine
- mt - magnetite
- o - olivine
- ph - phlogopite
- px - pyroxene
- q - quartz
- S - sulphide undifferentiated
- se - sericite
- si - silica
- sp - serpentinite
- t - talc
- tr - tremolite

SILVER SWAN NICKEL PROJECT
DIAMOND DRILL LOGS

HOLE	NORTH	EAST	AMG NORTH	AMG EAST	RL	AZIMUTH GRID	AZIMUTH MAG.	DIP	LENGTH	TENEMENT
BSD019	11799.654	10399.522	6637203.600	369905.895	1366.002	270.0	234.0	-60	460.00	M27/200

AZIMUTH	DIP	DEPTH	TYPE
270.00	-60.00	0.00	EASTMAN
270.00	-60.00	40.00	EASTMAN
270.00	-61.50	70.00	EASTMAN
270.00	-62.00	82.00	EASTMAN
272.00	-62.00	112.00	EASTMAN
272.00	-62.00	130.00	EASTMAN
273.00	-62.50	148.00	EASTMAN
274.00	-62.00	169.00	EASTMAN
274.00	-62.00	187.00	EASTMAN
274.00	-62.00	217.00	EASTMAN
275.00	-62.00	247.00	EASTMAN
275.00	-62.00	265.00	EASTMAN
275.00	-62.10	283.00	EASTMAN
275.50	-62.10	316.00	EASTMAN
277.00	-62.00	346.00	EASTMAN
277.00	-62.00	379.00	EASTMAN
275.00	-61.50	412.00	EASTMAN
275.00	-61.50	440.00	EASTMAN
273.50	-61.00	460.00	EASTMAN

BSD019

FROM (m)	TO (m)	LITHOLOGY	FROM (m)	TO (m)	SAMPLE NUMBER	LAB JOB NO	PX NO	As	Co	Cr	Cu	Fe %	Mg %	Ni %	S %	Zn	S:Ni	Fe:Ni
0.00	6.00	LAT																
6.00	14.00	CLAY																
14.00	17.00	CLAY																
17.00	23.00	CLAY																
23.00	34.00	SAP/FV/FPO?																
34.00	41.00	SAP/FV/FPO?																
41.00	72.00	FPO																
72.00	115.10	FPO/MLITH/BRECCIA																
115.10	115.90	SPX																
115.90	130.10	TA/CRB																
130.10	136.63	TA/CRB/FERRUG																
136.63	144.20	TA/CRB																
144.20	148.10	TA/CRB/FERRUG																
148.10	179.50	TA/CRB																
179.50	182.00	CHL/CRB/ALT HALO?																
182.00	184.20	TA/CRB																
184.20	186.30	FPO/MLITH/BRECCIA																
186.30	257.15	TA/CRB/oMC																
257.15	267.75	FI																
267.75	300.40	TA/CRB/oMC																
300.40	301.70	FI																
301.70	363.14	TA/CRB/oMC	362.00	363.09	53313	PE006878	1178	50	160	689	149			0.48	0.37	32	0.77	
363.14	363.16	SULPHIDE VEIN	363.09	363.19	53314	PE006878	1178	1343	1187	338	1739			2.88	15.10	21	5.24	
363.16	365.60	CRB/TA	363.19	364.00	53315	PE006878	1178	50	67	453	9			0.22	0.03	28	0.14	
365.60	370.00	FPO																
370.00	374.60	CRB/TA																
374.60	400.00	FPO/MSYN																
400.00	400.30	SPX																
400.30	409.30	TA/CRB																
409.30	414.40	RHYOLITE																
414.40	460.00	FV/LAVA																

SILVER SWAN NICKEL PROJECT
DIAMOND DRILL LOGS

HOLE	NORTH	EAST	AMG NORTH	AMG EAST	RL	AZIMUTH GRID	AZIMUTH MAG.	DIP	LENGTH	TENEMENT
BSD026	11749.821	10309.914	6637110.877	369862.198	1366.043	270.0	234.0	-60	343.00	M27/200

AZIMUTH	DIP	DEPTH	TYPE
270.00	-60.00	0.00	EASTMAN
271.00	-59.50	41.00	EASTMAN
271.50	-59.90	65.00	EASTMAN
272.50	-60.60	89.00	EASTMAN
273.00	-61.00	106.00	EASTMAN
272.50	-61.10	136.00	EASTMAN
272.00	-61.00	166.00	EASTMAN
271.00	-60.00	178.00	EASTMAN
273.00	-60.90	184.00	EASTMAN
270.00	-60.50	196.00	EASTMAN
271.00	-60.00	208.00	EASTMAN
271.00	-59.80	220.00	EASTMAN
272.00	-59.70	247.00	EASTMAN
272.00	-59.80	277.00	EASTMAN
273.50	-59.90	295.00	EASTMAN
275.00	-59.90	325.00	EASTMAN
273.00	-60.00	343.00	EASTMAN

3SD026

FROM (m)	TO (m)	LITHOLOGY	FROM (m)	TO (m)	SAMPLE NUMBER	LAB JOB NO	PX NO	As	Co	Cr	Cu	Fe %	Mg %	Ni %	S %	Zn	S:Ni	Fe:Ni
0.00	9.00	LAT																
9.00	14.00	CLAY/LAT																
14.00	23.00	CLAY																
23.00	40.00	CLAY/FPO?																
40.00	47.00	SAP/FV/FPO?																
47.00	94.00	SAP/FV/FPO?																
94.00	98.00	FV/FPO?																
98.00	134.80	FPO/MLITH/BRECCIA																
134.80	136.90	TA/CRB																
136.90	146.50	TA/CRB/WEATH																
146.50	202.00	TA/CRB																
202.00	223.05	TA/CRB/WEATH																
223.05	224.40	FPO?																
224.40	294.20	TA/CRB	250.00	251.00	41233	PE007523	1195	50	136	1242	172			0.53	0.84	51	1.58	
			251.00	252.00	41234	PE007523	1195	50	121	1037	129			0.47	0.69	52	1.47	
			252.00	253.00	41235	PE007523	1195	50	153	589	184			0.61	0.78	52	1.28	
			253.00	254.00	41236	PE007523	1195	50	128	558	187			0.56	0.79	46	1.41	
			254.00	255.00	41237	PE007523	1195	50	147	905	194			0.64	0.95	47	1.48	
			255.00	256.00	41238	PE007523	1195	50	147	964	219			0.62	0.63	49	1.02	
			256.00	257.00	41239	PE007523	1195	50	174	1525	362			0.86	1.12	69	1.30	
			257.00	258.00	41240	PE007523	1195	23	112	1909	491			0.64	0.74	85	1.16	
			258.00	259.00	41241	PE007523	1195	113	147	1196	418			0.65	1.17	58	1.80	
			259.00	260.00	41242	PE007523	1195	182	146	842	237			0.51	1.46	59	2.86	
			260.00	261.00	41243	PE007523	1195	51	219	555	770			1.22	1.56	71	1.28	
			261.00	262.00	41244	PE007523	1195	19	230	789	958			1.45	1.46	74	1.01	
			262.00	263.00	41245	PE007523	1195	30	210	742	841			1.28	1.38	76	1.08	
			263.00	264.00	41246	PE007523	1195	62	275	732	1096			1.62	2.11	76	1.30	
			264.00	265.00	41247	PE007523	1195	130	245	689	837			1.38	2.16	76	1.57	
			265.00	266.00	41249	PE007523	1195	54	255	738	1106			1.64	1.98	76	1.21	
			266.00	267.00	41250	PE007523	1195	143	305	696	1194			1.96	3.19	72	1.63	
			267.00	268.00	41251	PE007523	1195	71	253	716	1346			1.97	3.00	78	1.52	
			268.00	269.00	41252	PE007523	1195	65	192	971	820			1.34	1.87	75	1.40	
			269.00	270.00	41253	PE007523	1195	127	300	792	1073			1.71	3.16	67	1.85	
			270.00	271.00	41254	PE007523	1195	120	289	750	1275			1.94	3.07	59	1.58	
			271.00	272.00	41255	PE007523	1195	67	251	6624	1149			1.74	2.00	124	1.15	
			272.00	273.00	41256	PE007523	1195	55	259	695	1024			1.60	2.53	66	1.58	
			273.00	274.00	41257	PE007523	1195	54	226	290	697			1.32	2.25	77	1.70	
			274.00	275.00	41258	PE007523	1195	36	189	339	705			1.11	1.48	81	1.33	
			275.00	276.00	41259	PE007523	1195	47	192	276	564			0.95	1.77	82	1.86	
			276.00	277.00	41260	PE007523	1195	40	231	837	566			1.26	1.98	77	1.57	
			277.00	278.00	41261	PE007523	1195	40	171	594	526			0.93	1.53	50	1.65	
			278.00	279.00	41262	PE007523	1195	38	203	749	547			1.05	1.56	59	1.49	

CONTINUED...

SD026 *CONTINUED*

FROM (m)	TO (m)	LITHOLOGY	FROM (m)	TO (m)	SAMPLE NUMBER	LAB JOB NO	PX NO	As	Co	Cr	Cu	Fe %	Mg %	Ni %	S %	Zn	S:Ni	Fe:Ni
			279.00	280.00	41263	PE007523	1195	24	147	662	391			0.78	0.95	56	1.22	
			280.00	281.00	41264	PE007523	1195	65	209	568	616			1.12	2.10	55	1.88	
			281.00	282.00	41265	PE007523	1195	30	152	734	347			0.84	1.46	53	1.74	
			282.00	283.00	41266	PE007523	1195	29	150	727	336			0.77	1.32	47	1.71	
			283.00	284.00	41267	PE007523	1195	20	173	636	444			0.86	1.43	42	1.66	
			284.00	285.00	41268	PE007523	1195	16	143	864	269			0.62	1.01	40	1.63	
			285.00	286.00	41269	PE007523	1195	21	167	826	341			0.78	1.20	40	1.54	
			286.00	287.00	41270	PE007523	1195	16	99	758	114			0.33	0.27	40	0.82	
			287.00	288.00	41271	PE007523	1195	35	93	765	74			0.34	0.19	32	0.56	
			288.00	289.00	41272	PE007523	1195	105	201	2058	468			0.55	1.08	58	1.96	
			289.00	290.00	41273	PE007523	1195	709	78	918	45			0.23	0.077	33	0.33	
			290.00	291.00	41274	PE007523	1195	653	71	941	54			0.21	0.35	34	1.67	
			291.00	292.00	41275	PE007523	1195	197	70	971	143			0.22	0.45	42	2.05	
			292.00	293.00	41276	PE007523	1195	196	72	1029	175			0.24	0.19	45	0.79	
			293.00	294.00	41277	PE007523	1195	210	188	1114	793			0.46	1.70	61	3.70	
			294.00	294.20	41279	PE007523	1195	50	123	406	710			1.38	3.59	121	2.60	
294.20	297.80	MS	294.20	295.00	41201	PE007477	1194	50	3186	334	8933	35.50	0.83	12.10	34.80	26	2.88	2.93
			295.00	296.00	41202	PE007477	1194	50	1915	171	1189	35.90	0.24	17.20	35.60	15	2.07	2.09
			296.00	297.00	41203	PE007477	1194	50	2091	167	1656	36.00	0.10	18.40	34.80	15	1.89	1.96
			297.00	297.80	41205	PE007477	1194	50	1853	239	12200	35.90	0.33	14.90	33.90	85	2.28	2.41
297.80	298.30	KOM	297.80	298.30	41206	PE007477	1194	172	149	1990	2707			0.59	1.18	184	2.00	
298.30	299.65	MS	298.30	299.00	41207	PE007477	1194	523	1991	186	8037	34.40	0.25	14.60	33.30	45	2.28	2.36
			299.00	299.65	41208	PE007477	1194	4311	2673	439	10300	36.50	0.41	14.10	31.20	73	2.21	2.59
299.65	300.05	KOM?	299.65	300.05	41209	PE007477	1194	324	284	1663	1696			1.78	4.05	91	2.28	
300.05	300.80	MS	300.05	300.80	41210	PE007477	1194	208	1959	230	4604	36.90	0.37	13.70	33.60	45	2.45	2.69
300.80	301.45	KOM	300.80	301.00	41211	PE007477	1194	500	161	1733	637			0.74	1.02	244	1.38	
			301.00	301.15	41212	PE007477	1194	50	1926	257	7126	32.30	0.41	13.40	30.00	59	2.24	2.41
			301.15	301.45	41213	PE007477	1194	50	173	1635	4325			0.94	2.19	154	2.33	
301.45	303.70	MS	301.45	302.00	41214	PE007477	1194	50	1937	134	5297	35.90	0.26	14.60	34.00	34	2.33	2.46
			302.00	303.00	41215	PE007477	1194	140	1851	107	3570	35.10	0.31	14.40	32.20	32	2.24	2.44
			303.00	303.70	41216	PE007477	1194	50	2342	51	6251	33.50	0.30	11.60	30.80	47	2.66	2.89
303.70	304.35	FPO	303.70	304.35	41217	PE007477	1194	707	301	51	9414			0.96	3.09	115	3.22	
304.35	305.60	MS/FPO/KOM	304.35	305.00	41218	PE007477	1194	1960	891	40	3525	22.20	0.50	6.64	13.80	85	2.08	3.34
			305.00	305.50	41219	PE007477	1194	4354	616	194	1596			1.90	3.64	58	1.92	
305.60	306.70	MS/KOM	305.50	306.00	41220	PE007477	1194	47368	8014	120	7244	32.30	0.57	11.20	23.00	112	2.05	2.88
			306.00	306.70	41221	PE007477	1194	21281	2869	31	15000	31.90	0.33	12.30	25.20	136	2.05	2.59
306.70	315.55	MS	306.70	307.00	41222	PE007477	1194	313	2167	126	3677	36.30	0.13	13.80	33.50	40	2.43	2.63
			307.00	308.00	41223	PE007477	1194	176	1814	225	1398	36.50	0.08	15.60	33.60	31	2.15	2.34
			308.00	309.00	41224	PE007477	1194	50	1753	671	4458	37.20	0.13	15.80	32.70	86	2.07	2.35
			309.00	310.00	41225	PE007477	1194	50	1717	366	2351	34.20	0.12	15.50	34.50	58	2.23	2.21
			310.00	311.00	41226	PE007477	1194	1775	1733	177	1540	36.70	0.21	14.20	34.80	49	2.45	2.58
			311.00	312.00	41227	PE007477	1194	37451	5907	454	3529	32.60	0.31	12.60	30.60	101	2.43	2.59

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SD026 *CONTINUED*

FROM (m)	TO (m)	LITHOLOGY	FROM (m)	TO (m)	SAMPLE NUMBER	LAB JOB NO	PX NO	As	Co	Cr	Cu	Fe %	Mg %	Ni %	S %	Zn	S:Ni	Fe:Ni
			312.00	313.00	41228	PE007477	1194	421	1855	603	2411	38.30	0.11	13.80	35.50	64	2.57	2.78
			313.00	314.00	41229	PE007477	1194	3744	2247	272	3323	36.90	0.16	13.40	36.70	43	2.74	2.75
			314.00	315.00	41230	PE007477	1194	252	2081	47	3602	34.10	0.10	13.60	38.60	19	2.84	2.51
			315.00	315.55	41231	PE007477	1194	1696	2014	8	2441	29.27	0.15	15.50	34.80	28	2.25	1.89
315.55	342.00	FV/MLITH/LAVA	315.55	316.00	53612	PE007662	1196	2136	309	8	885			0.17	0.33	29	1.94	
			316.00	317.00	53613	PE007662	1196	102	2	18	22			0.01	0.024	7	2.40	
			317.00	317.55	53614	PE007662	1196	224	7	22	35			0.02	0.026	9	1.30	

SILVER SWAN NICKEL PROJECT
DIAMOND DRILL LOGS

HOLE	NORTH	EAST	AMG NORTH	AMG EAST	RL	AZIMUTH GRID	AZIMUTH MAG.	DIP	LENGTH	TENEMENT
BSD044	11649.834	10324.139	6637037.986	369932.061	1365.014	270.0	234.0	-60	340.00	M27/200

AZIMUTH	DIP	DEPTH	TYPE
270.00	-60.00	0.00	EASTMAN
271.00	-59.60	35.00	EASTMAN
272.00	-59.30	65.00	EASTMAN
273.00	-59.00	94.00	EASTMAN
268.00	-59.00	127.00	EASTMAN
269.50	-59.00	151.00	EASTMAN
269.50	-59.10	175.00	EASTMAN
269.50	-57.00	181.00	EASTMAN
269.50	-55.00	187.00	EASTMAN
269.50	-53.00	193.00	EASTMAN
269.50	-50.50	199.00	EASTMAN
271.50	-48.50	205.00	EASTMAN
273.00	-46.30	211.00	EASTMAN
273.50	-46.30	218.00	EASTMAN
271.50	-46.30	247.00	EASTMAN
272.50	-46.10	280.00	EASTMAN
272.00	-46.10	310.00	EASTMAN
271.00	-46.30	340.00	EASTMAN

SD044

ROM (m)	TO (m)	LITHOLOGY	FROM (m)	TO (m)	SAMPLE NUMBER	LAB JOB NO	PX NO	As	Co	Cr	Cu	Fe %	Mg %	Ni %	S %	Zn	S:Ni	Fe:Ni
.00	9.00	LAT																
.00	21.00	CLAY																
1.00	50.00	SAP/TA/CRB																
0.00	53.00	SAP/TA/CRB																
3.00	76.00	FPO/(PW)																
6.00	84.10	FPO																
4.10	102.50	FPOHLITH/CLASTIC																
02.50	104.50	FPO/WEATH																
04.50	138.40	FPO/MLITH/BRECCIA																
38.40	138.90	CRB/KOM?																
38.90	145.15	FPO/MLITH/BRECCIA																
45.15	145.85	KOM?																
45.85	147.65	FPO/MLITH/BRECCIA																
47.65	150.00	WEATH/FPO/KOM COMTACT																
50.00	162.65	TA/CRB/WEATH																
62.65	164.60	TA/CRB/WEATH																
64.60	175.00	TA/CRB																
75.00	211.50	NAVI DRILL																
11.50	270.00	TA/CRB																
70.00	275.00	TA/CRB/FRACT/SW	270.00	271.00	60063	PE012569	1534	15	89	600	8	4.24	20.59	0.24	0.016	35	0.07	17.67
			271.00	272.00	60064	PE012569	1534	5	100	769	7	4.61	20.90	0.24	0.016	41	0.07	19.21
			272.00	273.00	60065	PE012569	1534	5	109	761	49	4.92	20.00	0.27	0.055	32	0.20	18.22
			273.00	274.00	60066	PE012569	1534	27	99	1156	25	5.17	18.49	0.23	0.26	39	1.13	22.48
			274.00	275.00	60067	PE012569	1534	5	88	976	22	5.02	19.80	0.23	0.033	30	0.14	21.83
75.00	279.00	TA/CRB	275.00	276.00	60068	PE012569	1534	5	117	694	172	4.89	18.99	0.43	0.25	20	0.58	11.37
			276.00	277.00	60070	PE012569	1534	5	122	1502	250	5.76	18.93	0.53	0.35	23	0.66	10.87
			277.00	278.00	60071	PE012569	1534	19	123	624	248	5.55	18.67	0.48	0.49	22	1.02	11.56
			278.00	279.00	60072	PE012569	1534	13	100	511	199	4.56	18.85	0.40	0.37	17	0.92	11.40
79.00	297.08	TA/CRB/SULPH	279.00	280.00	60073	PE012569	1534	12	136	501	142	4.40	18.01	0.71	0.47	17	0.66	6.20
			280.00	281.00	45461	PE012563	1535	14	159	407	444	4.59	16.47	0.89	1.14	26	1.28	5.16
			281.00	282.00	45462	PE012563	1535	19	178	183	594	4.91	16.34	1.15	1.37	47	1.19	4.27
			282.00	282.75	45463	PE012563	1535	21	226	195	622	5.65	17.10	1.42	1.98	53	1.39	3.98
			282.75	283.47	45464	PE012563	1535	16	218	217	923	5.63	15.65	1.50	1.67	36	1.11	3.75
			283.47	284.00	45465	PE012563	1535	57	442	199	1184	8.93	15.66	3.05	6.30	42	2.07	2.93
			284.00	285.00	45466	PE012563	1535	58	445	164	1434	7.96	16.25	2.97	5.80	45	1.95	2.68
			285.00	286.00	45467	PE012563	1535	62	424	196	1374	7.92	16.90	2.87	5.56	46	1.94	2.76
			286.00	287.00	45468	PE012563	1535	63	447	211	1328	8.98	16.10	2.99	5.90	42	1.97	3.00
			287.00	288.00	45469	PE012563	1535	59	419	165	1031	7.92	15.37	2.60	5.87	42	2.26	3.05
			288.00	289.00	45471	PE012563	1535	56	407	188	1378	7.86	16.12	2.84	5.97	90	2.10	2.77
			289.00	290.00	45472	PE012563	1535	57	435	198	1534	7.78	17.17	2.91	6.10	53	2.10	2.67
			290.00	291.00	45473	PE012563	1535	65	418	214	1361	7.46	17.52	2.86	6.07	47	2.12	2.61
			291.00	292.00	45474	PE012563	1535	63	344	264	1159	7.37	17.60	2.35	4.91	48	2.09	3.14
			292.00	293.00	45475	PE012563	1535	48	362	338	1168	7.51	18.03	2.40	4.51	38	1.88	3.13
			293.00	294.00	45476	PE012563	1535	48	354	430	1295	7.49	18.34	2.40	4.18	32	1.74	3.12

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SD044 *CONTINUED*

ROM m)	TO (m)	LITHOLOGY	FROM (m)	TO (m)	SAMPLE NUMBER	LAB JOB NO	PX NO	As	Co	Cr	Cu	Fe %	Mg %	Ni %	S %	Zn	S:Ni	Fe:Ni
			294.00	295.00	45477	PE012563	1535	47	309	427	1192	7.14	17.47	2.11	3.57	39	1.69	3.38
			295.00	296.00	45478	PE012563	1535	49	308	449	894	7.06	17.64	2.05	3.20	41	1.56	3.44
			296.00	297.08	45479	PE012563	1535	27	242	553	928	6.14	17.77	1.65	2.34	43	1.42	3.72
97.08	311.22	TA/CRB/SULPH	297.08	297.45	45480	PE012563	1535	79	589	2275	1955	9.67	14.60	4.50	7.60	107	1.69	2.15
			297.45	298.35	45481	PE012563	1535	36	239	679	782	6.26	18.54	1.58	2.31	42	1.46	3.96
			298.35	299.00	45482	PE012563	1535	61	270	650	716	6.56	18.32	1.65	3.29	37	1.99	3.98
			299.00	300.00	45483	PE012563	1535	62	260	689	827	6.42	17.96	1.51	3.30	38	2.19	4.25
			300.00	300.90	45484	PE012563	1535	69	257	595	1126	6.45	17.82	1.75	2.75	39	1.57	3.69
			300.90	301.80	45485	PE012563	1535	168	332	380	1301	7.38	17.45	2.47	4.25	44	1.72	2.99
			301.80	302.65	45486	PE012563	1535	155	335	394	1509	7.86	18.20	2.36	3.80	48	1.61	3.33
			302.65	303.55	45487	PE012563	1535	131	222	396	1791	6.56	18.21	2.29	3.17	49	1.38	2.86
			303.55	303.75	45488	PE012563	1535	259	870	232	2272	10.73	14.38	8.22	12.50	38	1.52	1.31
			303.75	304.20	45489	PE012563	1535	72	305	502	1822	7.10	16.96	2.66	3.23	47	1.21	2.67
			304.20	305.06	45490	PE012563	1535	119	373	512	1514	7.96	15.62	3.51	4.48	43	1.28	2.27
			305.06	305.28	45491	PE012563	1535	548	984	627	3899	15.16	11.47	11.10	16.70	53	1.50	1.37
			305.28	306.00	45492	PE012563	1535	181	465	683	1945	9.19	16.04	3.59	5.50	42	1.53	2.56
			306.00	306.67	45494	PE012563	1535	105	416	1266	1426	10.14	14.40	7.28	7.04	74	0.97	1.39
			306.67	307.02	45495	PE012563	1535	64	365	3418	2791	11.36	13.88	7.71	6.26	167	0.81	1.47
			307.02	308.00	45496	PE012563	1535	55	461	3123	2988	10.66	16.90	4.05	4.05	106	1.00	2.63
			308.00	308.69	45497	PE012563	1535	76	382	1371	1862	8.44	16.75	2.69	3.40	49	1.26	3.14
			308.69	309.55	60074	PE012569	1534	46	245	574	895	7.01	19.49	2.31	2.39	37	1.03	3.03
			309.55	310.42	60075	PE012569	1534	25	175	550	707	5.83	20.43	1.25	1.31	39	1.05	4.66
			310.42	311.22	45498	PE012563	1535	27	238	826	329	5.11	18.42	1.43	1.50	37	1.05	3.57
311.22	317.77	CRB/TA	311.22	312.10	60076	PE012569	1534	14	71	484	59	4.09	20.48	0.26	0.24	24	0.92	15.73
			312.10	312.79	60077	PE012569	1534	5	65	508	36	4.38	21.45	0.23	0.22	25	0.96	19.04
			312.79	313.00	45499	PE012563	1535	48	172	548	142	4.07	18.43	1.02	0.95	34	0.93	3.99
			313.00	314.00	60078	PE012569	1534	21	67	462	43	4.28	20.20	0.27	0.34	22	1.26	15.85
			314.00	315.00	60079	PE012569	1534	273	98	491	70	4.14	19.45	0.41	0.42	25	1.02	10.10
			315.00	316.00	60080	PE012569	1534	317	66	555	33	4.33	19.47	0.24	0.16	29	0.67	18.04
			316.00	317.00	60082	PE012569	1534	147	90	491	24	3.88	18.28	0.28	0.19	39	0.68	13.86
			317.00	317.71	60083	PE012569	1534	436	70	535	11	3.85	17.31	0.19	0.071	30	0.37	20.26
317.77	320.08	CRB/KOM/Ooc	317.71	318.73	60084	PE012569	1534	1110	77	708	11	4.09	17.21	0.18	0.056	30	0.31	22.72
			318.73	319.51	60085	PE012569	1534	2200	93	850	17	5.10	15.85	0.23	0.12	34	0.52	22.17
			319.51	320.08	60086	PE012569	1534	4270	147	1713	120	10.50	11.39	0.32	0.22	81	0.69	32.81
320.08	340.00	FV/LAVA	320.08	321.00	60087	PE012569	1534	527	18	86	15	1.50	0.64	0.03	0.047	28	1.57	50.00
			321.00	322.00	60088	PE012569	1534	107	7	30	16	0.89	0.47	0.01	0.017	11	1.70	89.00

SILVER SWAN NICKEL PROJECT
DIAMOND DRILL LOGS

HOLE	NORTH	EAST	AMG NORTH	AMG EAST	RL	AZIMUTH GRID	AZIMUTH MAG.	DIP	LENGTH	TENEMENT
BSD044A	11649.834	10324.139	6637037.986	369932.061	1365.014	270.0	234.0	-60	377.00	M27/200

WEDGED OF BSD44

AZIMUTH	DIP	DEPTH	TYPE
269.50	-58.75	176.00	COLLAR
269.50	-58.20	176.10	CALC.
269.50	-58.20	187.00	EASTMAN
275.00	-60.50	196.50	EASTMAN
278.00	-62.80	205.50	EASTMAN
278.00	-63.20	212.00	EASTMAN
277.50	-63.50	241.00	EASTMAN
278.00	-63.40	271.00	EASTMAN
278.00	-63.00	301.00	EASTMAN
279.50	-63.10	331.00	EASTMAN
278.00	-63.00	361.00	EASTMAN
278.50	-63.00	377.00	EASTMAN

SD044A

ROM (m)	TO (m)	LITHOLOGY	FROM (m)	TO (m)	SAMPLE NUMBER	LAB JOB NO	PX NO	As	Co	Cr	Cu	Fe %	Mg %	Ni %	S %	Zn	S:Ni	Fe:Ni
77.80	187.00	TA/CRB																
87.00	205.10	NAVI DRILL																
05.10	209.75	CRB/TA/FPO?	205.10	206.00	84735	PE023285	2228		51	274	2	2.26	14.49	0.17	0.00	30	0.00	13.29
			206.00	207.00	84736	PE023285	2228		68	411	2	3.00	17.85	0.21	0.00	16	0.00	14.29
			207.00	208.00	84737	PE023285	2228		72	433	2	3.07	18.11	0.21	0.00	15	0.00	14.62
			208.00	209.00	84738	PE023285	2228		72	447	48	3.21	18.77	0.21	0.04	24	0.19	15.29
			209.00	209.75	84739	PE023285	2228		67	373	14	3.20	19.11	0.19	0.04	24	0.21	16.84
09.75	212.50	TA/CRB	209.75	211.00	84740	PE023285	2228		66	366	5	3.18	19.09	0.20	0.02	23	0.10	15.90
			211.00	212.00	84741	PE023285	2228		77	408	2	3.73	20.84	0.22	0.03	37	0.14	16.95
12.50	223.50	TA/CRB	212.00	213.00	84742	PE023285	2228		80	361	2	3.05	20.19	0.22	0.01	27	0.05	13.86
			213.00	214.00	84743	PE023285	2228		78	365	2	2.77	20.64	0.22	0.03	21	0.14	12.59
			214.00	215.00	84744	PE023285	2228		74	306	2	2.50	20.00	0.22	0.00	20	0.00	11.36
23.50	227.30	TA/CRB/WEATH																
27.30	273.80	TA/CRB																
73.80	279.00	TA/CRB																
79.00	287.00	TA/CRB/WEATH																
87.00	291.00	TA/CRB																
91.00	298.00	TA/CRB/SW																
98.00	330.19	TA/CRB/SULPH	301.00	302.00	60113	PE012867	1538	72	96	598	268	3.91	19.02	0.32	0.035	37	0.11	12.22
			302.00	303.00	60114	PE012867	1538	14	189	614	401	4.57	19.80	0.76	0.69	35	0.91	6.01
			303.00	304.00	60115	PE012867	1538	27	250	686	297	5.68	19.21	0.91	2.60	29	2.86	6.24
			304.00	305.00	60116	PE012867	1538	15	248	845	298	5.67	20.40	1.00	1.90	30	1.90	5.67
			305.00	306.00	60117	PE012867	1538	24	182	902	443	5.38	20.40	1.10	1.42	31	1.29	4.89
			306.00	307.00	60118	PE012867	1538	25	215	808	425	5.79	21.35	0.98	1.62	29	1.65	5.91
			307.00	308.00	60119	PE012867	1538	24	235	734	469	5.11	20.70	1.07	1.68	32	1.57	4.78
			308.00	309.00	60120	PE012867	1538	30	243	599	410	5.51	20.41	1.05	2.28	26	2.17	5.25
			309.00	310.00	60121	PE012867	1538	34	204	657	406	5.33	20.58	0.92	1.68	28	1.83	5.79
			310.00	311.00	60122	PE012867	1538	36	212	651	394	5.64	20.88	0.93	1.87	26	2.01	6.06
			311.00	312.00	60123	PE012867	1538	44	237	621	433	5.81	20.10	1.10	2.42	23	2.20	5.28
			312.00	313.00	60125	PE012867	1538	32	223	640	409	5.58	20.10	1.01	1.74	23	1.72	5.52
			313.00	314.00	60126	PE012867	1538	24	199	744	431	5.36	20.11	0.98	1.67	29	1.70	5.47
			314.00	315.00	60127	PE012867	1538	33	203	664	424	5.53	20.30	1.06	2.02	24	1.91	5.22
			315.00	316.00	60128	PE012867	1538	24	236	689	514	5.35	20.21	1.22	1.78	30	1.46	4.39
			316.00	317.00	60129	PE012867	1538	28	237	592	447	5.04	20.40	1.15	1.37	29	1.19	4.38
			317.00	318.00	60130	PE012867	1538	23	178	559	358	4.83	20.10	0.90	1.13	36	1.26	5.37
			318.00	319.00	60131	PE012867	1538	34	211	403	375	5.62	20.83	0.91	1.89	30	2.08	6.18
			319.00	320.00	60132	PE012867	1538	32	179	488	416	5.10	20.19	0.89	1.38	26	1.55	5.73
			320.00	321.00	60133	PE012867	1538	46	203	459	365	5.16	20.51	0.88	1.80	33	2.05	5.86
			321.00	322.00	60134	PE012867	1538	41	218	511	457	5.54	20.39	0.88	1.78	30	2.02	6.30
			322.00	323.00	60135	PE012867	1538	49	228	491	467	5.25	20.00	0.90	1.95	29	2.17	5.83
			323.00	324.00	60136	PE012867	1538	38	219	467	441	5.34	20.30	0.87	1.86	36	2.14	6.14
			324.00	325.00	60137	PE012867	1538	52	234	442	610	5.51	20.30	1.01	2.01	30	1.99	5.46
			325.00	326.00	60138	PE012867	1538	59	233	392	447	5.65	20.00	0.93	2.27	28	2.44	6.08
			326.00	326.80	60139	PE012867	1538	63	238	322	516	5.68	20.50	0.98	2.53	37	2.58	5.80

CONTINUED...

BSD044A *CONTINUED*

FROM (m)	TO (m)	LITHOLOGY	FROM (m)	TO (m)	SAMPLE NUMBER	LAB JOB NO	PX NO	As	Co	Cr	Cu	Fe %	Mg %	Ni %	S %	Zn	S:Ni	Fe:Ni
			326.80	327.56	60140	PE012867	1538	44	203	286	454	5.22	20.80	0.78	1.88	31	2.41	6.69
			327.56	329.00	60141	PE012867	1538	56	188	248	457	5.33	20.90	0.81	1.89	63	2.33	6.58
			329.00	330.19	60142	PE012867	1538	74	212	230	508	5.61	20.21	0.89	2.34	59	2.63	6.30
330.19	330.48	TA/CRB	330.19	330.48	45601	PE012868	1539	309	521	140	927	10.73	17.19	1.54	8.74	28	5.68	6.97
330.48	344.05	TA/CRB	330.48	331.42	45602	PE012868	1539	78	226	237	524	5.50	20.10	0.98	2.00	26	2.04	5.61
			331.42	332.28	45603	PE012868	1539	81	210	242	549	5.37	20.50	0.88	1.77	30	2.01	6.10
			332.28	333.41	45604	PE012868	1539	115	246	221	589	5.78	20.10	0.98	2.33	34	2.38	5.90
			333.41	334.24	45606	PE012868	1539	57	211	243	611	5.11	20.61	0.95	1.36	32	1.43	5.38
			334.24	335.33	45607	PE012868	1539	79	229	272	801	5.46	20.20	1.12	2.07	33	1.85	4.87
			335.33	336.10	45608	PE012868	1539	110	214	240	801	5.43	19.81	1.38	2.33	33	1.69	3.93
			336.10	336.82	45609	PE012868	1539	64	212	234	994	5.35	19.61	1.35	1.94	38	1.44	3.96
			336.82	337.14	45610	PE012868	1539	173	358	194	1508	6.82	19.90	1.98	4.53	36	2.29	3.44
			337.14	338.00	45611	PE012868	1539	87	215	203	1071	5.71	19.81	1.42	2.37	38	1.67	4.02
			338.00	338.85	45612	PE012868	1539	90	220	225	892	5.56	20.30	1.31	2.36	38	1.80	4.24
			338.85	339.68	45613	PE012868	1539	97	220	260	1055	5.56	20.30	1.33	2.37	45	1.78	4.18
			339.68	340.74	45614	PE012868	1539	134	283	217	1561	6.56	19.71	1.94	3.72	41	1.92	3.38
			340.74	341.89	45615	PE012868	1539	98	239	233	1087	6.08	19.79	1.49	2.61	46	1.75	4.08
			341.89	342.47	45616	PE012868	1539	100	220	194	1616	5.87	20.49	1.57	2.85	78	1.82	3.74
			342.47	343.26	45617	PE012868	1539	57	213	239	1340	5.73	20.00	1.40	2.28	45	1.63	4.09
			343.26	344.05	45618	PE012868	1539	74	240	283	1533	6.04	19.59	2.10	2.90	47	1.38	2.88
344.05	351.28	TA/CRB	344.05	344.91	45619	PE012868	1539	487	769	123	3495	14.06	14.65	6.50	12.46	53	1.92	2.16
			344.91	345.75	45620	PE012868	1539	1290	722	117	3690	13.50	14.40	5.93	12.25	50	2.07	2.28
			345.75	346.36	45621	PE012868	1539	1060	394	351	1899	8.57	17.98	3.08	4.91	38	1.59	2.78
			346.36	347.19	45623	PE012868	1539	272	522	346	1779	10.00	16.63	3.76	6.62	48	1.76	2.66
			347.19	348.00	45624	PE012868	1539	545	466	351	2079	8.92	17.93	3.51	5.67	43	1.62	2.54
			348.00	349.00	45625	PE012868	1539	494	399	704	1851	8.16	18.31	3.07	4.81	50	1.57	2.66
			349.00	349.88	45626	PE012868	1539	241	419	1186	2010	8.85	17.25	3.29	5.53	61	1.68	2.69
			349.88	350.58	45627	PE012868	1539	185	545	2593	3589	10.53	16.27	4.36	7.38	114	1.69	2.42
			350.58	351.28	45628	PE012868	1539	132	563	1960	3040	10.80	16.60	4.53	6.74	99	1.49	2.38
351.28	355.57	CRB/TA	351.28	352.12	45629	PE012868	1539	318	345	1025	1295	7.54	18.55	2.45	3.28	52	1.34	3.08
			352.12	353.00	60143	PE012867	1538	498	104	583	115	4.63	19.70	0.45	0.50	54	1.11	10.29
			353.00	354.00	60144	PE012867	1538	95	97	630	70	4.25	20.30	0.31	0.36	36	1.16	13.71
			354.00	355.00	60145	PE012867	1538	651	75	612	24	3.99	19.60	0.27	0.17	28	0.63	14.78
355.57	358.93	CRB/KOM/Ooc	355.00	355.58	60146	PE012867	1538	936	96	508	26	3.54	17.09	0.39	0.27	19	0.69	9.08
			355.58	355.86	60148	PE012867	1538	716	45	257	24	2.19	10.70	0.10	0.15	101	1.50	21.90
			355.86	356.21	60149	PE012867	1538	1500	97	858	2	4.76	19.50	0.20	0.068	32	0.34	23.80
			356.21	357.00	60150	PE012867	1538	1680	95	1069	25	4.04	17.25	0.21	0.094	33	0.45	19.24
			357.00	358.00	60151	PE012867	1538	1780	104	1080	2	4.82	18.70	0.20	0.075	33	0.37	24.10
			358.00	358.93	60152	PE012867	1538	3410	101	1353	28	6.03	10.39	0.23	0.16	41	0.70	26.22
358.93	376.50	FV/LAVA	358.93	360.00	60153	PE012867	1538	596	6	38	12	1.61	0.64	0.01	0.033	12	3.30	161.00
			360.00	360.66	45630	PE012868	1539	6640	22	46	21	5.06	1.89	0.04	0.30	42	7.50	126.50
			360.66	361.45	45631	PE012868	1539	31400	13	23	19	4.67	1.51	0.01	1.32	31	132.00	467.00
			361.45	362.00	60154	PE012867	1538	3300	14	16	318	3.41	1.16	0.01	0.18	29	18.00	341.00
			362.00	363.00	60155	PE012867	1538	444	15	21	413	3.24	1.15	0.01	0.063	25	6.30	324.00
376.50	377.00	CRB/SERICITE/SHEAR																

SILVER SWAN NICKEL PROJECT
DIAMOND DRILL LOGS

HOLE	NORTH	EAST	AMG NORTH	AMG EAST	RL	AZIMUTH GRID	AZIMUTH MAG.	DIP	LENGTH	TENEMENT
BSD052	11749.492	10325.030	6637119.426	369874.664	1365.998	270.0	234.0	-60	367.00	M27/200

AZIMUTH	DIP	DEPTH	TYPE
270.00	-59.00	0.00	EASTMAN
270.00	-58.00	31.00	EASTMAN
270.50	-60.00	61.00	EASTMAN
271.00	-62.20	97.00	EASTMAN
271.00	-62.00	109.00	EASTMAN
273.00	-62.80	121.00	EASTMAN
273.50	-62.40	133.00	EASTMAN
273.50	-62.30	145.00	EASTMAN
273.00	-62.50	163.00	EASTMAN
273.00	-62.50	169.00	EASTMAN
270.00	-60.50	175.00	EASTMAN
266.00	-58.00	184.00	EASTMAN
265.00	-58.00	191.00	EASTMAN
265.00	-56.00	197.00	EASTMAN
265.00	-54.00	202.00	EASTMAN
263.00	-54.00	206.00	EASTMAN
263.00	-54.00	220.00	EASTMAN
263.00	-54.10	238.00	EASTMAN
262.00	-54.20	256.00	EASTMAN
269.00	-54.00	262.00	EASTMAN
269.00	-54.50	272.00	EASTMAN
269.00	-54.50	289.00	EASTMAN
269.50	-54.70	319.00	EASTMAN
270.00	-54.80	349.00	EASTMAN
270.00	-54.80	367.00	EASTMAN

SD052

ROM (m)	TO (m)	LITHOLOGY	FROM (m)	TO (m)	SAMPLE NUMBER	LAB JOB NO	PX NO	As	Co	Cr	Cu	Fe %	Mg %	Ni %	S %	Zn	S:Ni	Fe:Ni
.00	4.00	LAT																
.00	10.00	LAT																
0.00	16.00	Fe/CLAY																
6.00	20.00	CLAY/TA/CRB																
0.00	31.00	CLAY/CRB/TA																
1.00	40.00	SAP/CRB/TA																
0.00	52.00	SAP/CRB/TA																
2.00	71.00	FPO																
1.00	83.00	FPO/WEATH																
3.00	99.00	TA/CRB																
9.00	102.00	TA/CRB/SW																
.02.00	111.00	TA/CRB																
.11.00	117.10	CRB/TA/SW																
.17.10	144.80	FPO/MLITH/BRECCIA																
.44.80	157.00	CRB/TA/SW																
.57.00	169.00	CRB/TA																
.69.00	184.50	NAVI DRILL																
.84.50	191.00	CRB/TA																
.91.00	202.00	NAVI DRILL																
02.00	256.00	CRB/TA																
56.00	263.00	NAVI DRILL																
63.00	298.00	TA/CRB	265.00	266.00	60596	PE014099	1570	5	96	799	145	5.46	16.62	0.31	0.38	45	1.23	17.61
			266.00	267.00	60597	PE014099	1570	21	124	829	146	5.82	17.91	0.38	0.46	47	1.21	15.32
			267.00	268.00	60598	PE014099	1570	32	153	1124	168	5.97	19.26	0.49	0.64	57	1.31	12.18
			268.00	269.00	60599	PE014099	1570	48	169	1010	178	6.25	19.37	0.54	1.08	52	2.00	11.57
			269.00	270.00	60600	PE014099	1570	32	144	1124	168	6.09	19.30	0.47	0.72	55	1.53	12.96
			270.00	271.00	60601	PE014099	1570	48	165	1039	197	6.18	18.62	0.56	0.81	49	1.45	11.04
			271.00	272.00	60602	PE014099	1570	51	144	1143	181	6.38	18.76	0.54	0.84	53	1.56	11.81
			272.00	273.00	60603	PE014099	1570	100	177	1111	249	6.41	17.83	0.64	1.19	53	1.86	10.02
			273.00	274.00	60604	PE014099	1570	96	175	1556	299	7.05	16.75	0.65	1.14	69	1.75	10.85
			274.00	275.00	60605	PE014099	1570	22	125	1483	108	6.34	16.70	0.26	0.68	64	2.62	24.38
			275.00	276.00	60606	PE014099	1570	36	139	1707	218	7.39	17.12	0.41	0.87	62	2.12	18.02
			276.00	277.00	60607	PE014099	1570	19	124	1141	243	7.07	16.97	0.40	0.80	65	2.00	17.68
			277.00	278.00	60608	PE014099	1570	62	158	1230	390	6.79	16.59	0.58	1.19	72	2.05	11.71
			278.00	279.00	60609	PE014099	1570	20	104	1113	209	6.57	16.99	0.29	0.54	67	1.86	22.66
			279.00	280.00	60610	PE014099	1570	26	139	1136	165	5.80	16.78	0.27	0.72	56	2.67	21.48
			280.00	281.00	60612	PE014099	1570	50	89	276	225	4.24	16.08	0.34	0.41	46	1.21	12.47
			281.00	282.00	60613	PE014099	1570	28	83	885	123	5.65	16.76	0.21	0.49	57	2.33	26.90
			282.00	283.00	60614	PE014099	1570	28	85	954	38	5.20	16.61	0.17	0.31	58	1.82	30.59
			283.00	284.00	60615	PE014099	1570	60	132	885	207	5.19	16.57	0.45	0.83	54	1.84	11.53
			284.00	285.00	60616	PE014099	1570	37	138	803	337	5.31	14.44	0.46	1.26	41	2.74	11.54
			285.00	286.00	60617	PE014099	1570	64	201	962	474	5.91	16.51	0.92	1.83	39	1.99	6.42
			286.00	287.00	60618	PE014099	1570	31	143	855	116	4.63	19.89	0.35	0.37	37	1.06	13.23
			287.00	288.00	60619	PE014099	1570	18	84	702	80	4.89	20.43	0.26	0.29	37	1.12	18.81

CONTINUED...

3SD052 *CONTINUED*

FROM (m)	TO (m)	LITHOLOGY	FROM (m)	TO (m)	SAMPLE NUMBER	LAB JOB NO	PX NO	As	Co	Cr	Cu	Fe %	Mg %	Ni %	S %	Zn	S:Ni	Fe:Ni
			288.00	289.00	60620	PE014099	1570	34	150	656	169	5.82	19.21	0.57	0.92	35	1.61	10.21
			289.00	290.00	60621	PE014099	1570	46	223	5673	496	6.69	17.80	1.17	1.46	94	1.25	5.72
			290.00	291.00	60622	PE014099	1570	35	198	2597	536	6.67	19.91	0.88	1.02	49	1.16	7.58
			291.00	292.00	60623	PE014099	1570	33	221	1572	689	4.00	0.00	0.97	1.51	43	1.56	4.12
			292.00	293.00	60624	PE014099	1570	45	211	1220	670	6.65	19.26	0.93	1.62	43	1.74	7.15
			293.00	294.00	60625	PE014099	1570	45	240	1447	715	7.20	19.01	1.16	1.75	50	1.51	6.21
			294.00	295.00	60626	PE014099	1570	57	260	1749	960	7.58	19.05	1.37	2.07	62	1.51	5.53
			295.00	296.00	60627	PE014099	1570	62	210	1301	865	6.73	19.01	1.07	2.04	55	1.91	6.29
			296.00	297.00	60628	PE014099	1570	67	234	1364	865	7.12	19.45	1.30	2.19	66	1.68	5.48
			297.00	298.00	60629	PE014099	1570	33	166	615	503	6.35	20.65	0.80	0.87	47	1.09	7.94
298.00	313.65	CRB/TA	298.00	299.00	60631	PE014099	1570	44	171	703	380	5.74	20.54	0.69	0.65	36	0.94	8.32
			299.00	300.00	60632	PE014099	1570	309	141	722	278	5.28	21.09	0.52	0.53	37	1.02	10.15
			300.00	301.00	60633	PE014099	1570	369	114	677	125	4.81	21.40	0.31	0.24	30	0.77	15.52
			301.00	302.00	60634	PE014099	1570	223	90	945	106	5.02	21.09	0.25	0.15	36	0.60	20.08
			302.00	303.00	60635	PE014099	1570	399	96	792	81	5.09	22.06	0.23	0.12	37	0.52	22.13
			303.00	304.00	60636	PE014099	1570	204	112	900	146	5.44	21.00	0.40	0.36	43	0.90	13.60
			304.00	305.00	60637	PE014099	1570	351	121	833	38	5.44	21.95	0.24	0.14	36	0.58	22.67
			305.00	306.00	60638	PE014099	1570	499	99	886	26	4.87	21.50	0.21	0.09	39	0.43	23.19
			306.00	307.00	60639	PE014099	1570	460	92	841	47	4.84	20.79	0.20	0.069	44	0.35	24.20
			307.00	308.00	60640	PE014099	1570	140	111	975	207	5.68	19.70	0.31	0.35	40	1.13	18.32
			308.00	309.00	60641	PE014099	1570	377	101	855	90	5.38	21.29	0.25	0.14	43	0.56	21.52
			309.00	310.00	60642	PE014099	1570	205	109	904	507	4.98	19.19	0.29	0.27	46	0.93	17.17
			310.00	311.00	60643	PE014099	1570	109	98	879	154	5.40	20.02	0.29	0.21	47	0.72	18.62
			311.00	312.00	60644	PE014099	1570	98	97	937	153	4.99	18.03	0.26	0.20	45	0.77	19.19
			312.00	313.00	60645	PE014099	1570	73	88	977	146	4.92	16.44	0.24	0.20	48	0.83	20.50
			313.00	313.65	60646	PE014099	1570	92	112	1183	408	6.27	13.56	0.45	0.71	60	1.58	13.93
313.65	319.26	MS	313.65	314.00	45996	PE014100	1571	369	1571	130	2518	43.76	0.19	15.90	35.70	26	2.25	2.75
			314.00	315.00	45997	PE014100	1571	640	1987	96	5040	43.40	0.17	16.40	35.50	35	2.16	2.65
			315.00	316.00	45998	PE014100	1571	192	1803	140	2526	43.12	0.16	16.20	35.10	27	2.17	2.66
			316.00	317.00	45999	PE014100	1571	45	1550	95	7750	44.27	0.12	15.90	36.30	63	2.28	2.78
			317.00	318.00	46000	PE014100	1571	33	1497	168	2784	44.06	0.15	16.60	35.60	44	2.14	2.65
			318.00	319.26	46001	PE014100	1571	1890	1575	135	3843	44.02	0.12	15.80	33.60	51	2.13	2.79
319.26	326.28	FV/LAVA	319.26	320.00	46003	PE014100	1571	2800	830	85	6289	14.10	0.66	3.89	8.55	72	2.20	3.62
			320.00	321.00	46004	PE014100	1571	1780	33	24	525	1.73	0.94	0.39	0.46	18	1.18	4.44
			321.00	322.00	46005	PE014100	1571	4980	231	19	2383	4.99	1.16	2.46	3.42	31	1.39	2.03
			322.00	323.00	46006	PE014100	1571	8670	427	20	4980	6.47	1.60	5.83	6.03	46	1.03	1.11
			323.00	324.00	46007	PE014100	1571	9200	378	217	2636	5.28	2.47	4.40	4.39	60	1.00	1.20
			324.00	325.00	46008	PE014100	1571	23900	313	456	2912	8.28	3.44	2.50	3.73	88	1.49	3.31
			325.00	326.28	46009	PE014100	1571	13800	1275	485	3095	16.64	2.64	3.91	7.85	102	2.01	4.26
326.28	327.38	MS	326.28	327.38	46011	PE014100	1571	1520	1474	53	1631	40.00	0.17	15.30	33.40	35	2.18	2.61
327.38	330.00	FV/LAVA	327.38	328.00	46012	PE014100	1571	8340	1216	41	6985	21.74	0.43	4.04	9.52	130	2.36	5.38
			328.00	329.00	46013	PE014100	1571	763	19	17	211	2.16	2.65	0.09	0.10	24	1.11	24.00
			329.00	330.00	46014	PE014100	1571	1390	14	56	187	1.96	3.45	0.12	0.11	25	0.92	16.33
330.00	367.00	FV/LAVA	330.00	331.00	46015	PE014100	1571	165	6	23	38	1.43	1.98	0.02	0.023	19	1.15	71.50
			331.00	332.00	46016	PE014100	1571	112	10	17	12	1.42	2.04	0.01	0.03	17	3.00	142.00

SILVER SWAN NICKEL PROJECT
DIAMOND DRILL LOGS

HOLE	NORTH	EAST	AMG NORTH	AMG EAST	RL	AZIMUTH GRID	AZIMUTH MAG.	DIP	LENGTH	TENEMENT
BSD052A	11749.492	10325.030	6637119.426	369874.664	1365.998	270.0	234.0	-60	337.00	M27/200

WEDGED OF BSD52

AZIMUTH	DIP	DEPTH	TYPE
273.00	-62.50	169.00	COLLAR
273.00	-62.50	169.10	CALC.
273.00	-62.50	181.00	EASTMAN
273.00	-60.50	187.00	EASTMAN
273.00	-58.50	193.00	EASTMAN
274.00	-56.80	200.00	EASTMAN
275.00	-56.90	203.00	EASTMAN
275.00	-56.80	206.00	EASTMAN
278.00	-57.00	211.00	EASTMAN
278.00	-57.00	215.00	EASTMAN
278.00	-57.00	229.00	EASTMAN
278.50	-57.00	259.00	EASTMAN
279.00	-57.40	289.00	EASTMAN
280.00	-58.00	331.00	EASTMAN

3SD052A

FROM (m)	TO (m)	LITHOLOGY	FROM (m)	TO (m)	SAMPLE NUMBER	LAB JOB NO	PX NO	As	Co	Cr	Cu	Fe %	Mg %	Ni %	S %	Zn	S:Ni	Fe:Ni
170.00	181.00	CRB/TA																
181.00	198.50	NAVI DRILL																
198.50	206.00	CRB/TA																
206.00	211.40	NAVI DRILL																
211.40	247.00	CRB/TA																
247.00	260.20	TA/CRB																
260.20	261.70	TA/CRB/SHEAR																
261.70	308.87	TA/CRB	265.00	266.00	60554	PE013992	1568	31	104	946	65	5.21	19.61	0.21	0.03	53	0.14	24.81
			266.00	267.00	60555	PE013992	1568	5	159	1393	83	5.78	18.50	0.41	0.35	50	0.85	14.10
			267.00	268.00	60556	PE013992	1568	5	91	600	34	4.67	17.85	0.25	0.11	40	0.44	18.68
			268.00	269.00	60557	PE013992	1568	5	87	884	64	4.74	19.59	0.28	0.15	42	0.54	16.93
			269.00	270.00	60558	PE013992	1568	17	121	618	46	4.47	18.33	0.31	0.68	36	2.19	14.42
			270.00	271.00	60559	PE013992	1568	20	69	768	86	4.49	17.46	0.29	0.24	41	0.83	15.48
			271.00	272.00	60560	PE013992	1568	5	109	753	36	5.13	18.81	0.21	0.81	43	3.86	24.43
			272.00	273.00	60561	PE013992	1568	5	87	704	24	4.65	18.69	0.21	0.69	35	3.29	22.14
			273.00	274.00	60562	PE013992	1568	5	91	653	26	4.94	18.79	0.19	0.095	43	0.50	26.00
			274.00	275.00	60563	PE013992	1568	747	438	915	99	11.15	14.90	0.42	3.81	48	9.07	26.55
			275.00	276.00	60564	PE013992	1568	56	99	2010	141	7.82	16.83	0.24	0.075	62	0.31	32.58
			276.00	277.00	60565	PE013992	1568	173	144	2083	297	6.68	17.53	0.47	0.36	59	0.77	14.21
			277.00	278.00	60566	PE013992	1568	1270	276	2356	384	8.21	17.80	0.73	1.75	58	2.40	11.25
			278.00	279.00	60567	PE013992	1568	920	160	2385	346	6.36	17.28	0.67	0.99	59	1.48	9.49
			279.00	280.00	60568	PE013992	1568	191	154	1717	658	6.86	18.21	0.92	0.98	64	1.07	7.46
			280.00	281.00	60569	PE013992	1568	87	205	941	751	7.56	17.61	1.23	2.01	64	1.63	6.15
			281.00	282.00	60570	PE013992	1568	283	147	781	527	6.08	18.84	0.83	0.74	57	0.89	7.33
			282.00	283.00	60571	PE013992	1568	416	147	803	481	6.15	19.30	0.76	0.63	55	0.83	8.09
			283.00	284.00	60573	PE013992	1568	632	192	801	931	6.11	18.58	1.02	0.97	52	0.95	5.99
			284.00	285.00	60574	PE013992	1568	439	131	1073	364	5.81	18.73	0.65	0.44	55	0.68	8.94
			285.00	286.00	60575	PE013992	1568	334	112	977	279	5.75	18.77	0.57	0.33	52	0.58	10.09
			286.00	287.00	60576	PE013992	1568	424	155	1099	454	5.94	18.69	0.78	0.57	54	0.73	7.62
			287.00	288.00	60577	PE013992	1568	400	133	1236	372	5.74	18.77	0.63	0.44	62	0.70	9.11
			288.00	289.00	60578	PE013992	1568	347	125	1140	297	5.74	18.65	0.47	0.33	59	0.70	12.21
			289.00	290.00	60579	PE013992	1568	220	125	1182	347	6.00	18.72	0.49	0.31	53	0.63	12.24
			290.00	291.00	60580	PE013992	1568	99	125	1427	411	5.92	17.00	0.52	0.54	63	1.04	11.38
			291.00	292.00	60581	PE013992	1568	85	122	1302	404	6.07	17.25	0.50	0.49	55	0.98	12.14
			292.00	293.00	60582	PE013992	1568	17	134	2065	758	6.56	16.02	0.85	1.05	69	1.24	7.72
			293.00	294.00	60583	PE013992	1568	40	148	1970	702	6.99	15.64	0.82	1.09	70	1.33	8.52
			294.00	295.00	60584	PE013992	1568	22	92	1869	113	6.81	15.33	0.21	0.043	66	0.20	32.43
			295.00	296.00	60585	PE013992	1568	166	133	793	85	5.56	17.13	0.28	0.04	48	0.14	19.86
			296.00	297.00	60586	PE013992	1568	174	154	2037	188	5.71	16.56	0.33	0.18	61	0.55	17.30
			297.00	298.00	60587	PE013992	1568	50	202	1704	505	6.96	16.33	0.93	1.75	50	1.88	7.48
			298.00	299.00	60589	PE013992	1568	5	124	6715	208	6.11	16.06	0.49	0.38	138	0.78	12.47
			299.00	300.00	60590	PE013992	1568	12	103	1009	32	4.79	17.94	0.21	0.37	38	1.76	22.81
			300.00	301.00	60591	PE013992	1568	5	78	772	25	4.43	18.32	0.19	0.24	34	1.26	23.32
			301.00	302.00	60592	PE013992	1568	5	89	1014	23	4.87	17.97	0.19	0.34	38	1.79	25.63

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BSD052A *CONTINUED*

FROM (m)	TO (m)	LITHOLOGY	FROM (m)	TO (m)	SAMPLE NUMBER	LAB JOB NO	PX NO	As	Co	Cr	Cu	Fe %	Mg %	Ni %	S %	Zn	S:Ni	Fe:Ni
			302.00	303.00	60593	PE013992	1568	5	88	1152	17	4.98	17.70	0.20	0.31	37	1.55	24.90
			303.00	304.00	60594	PE013992	1568	5	102	894	25	5.29	16.85	0.20	1.00	36	5.00	26.45
			304.00	305.00	60595	PE013992	1568	5	87	1382	41	5.33	16.57	0.19	0.40	44	2.11	28.05
			305.00	306.00	45967	PE013991	1569	38	73	841	28	5.14	16.18	0.19	0.04	41	0.21	27.05
			306.00	307.00	45968	PE013991	1569	66	112	984	95	7.38	17.35	0.34	1.00	46	2.94	21.71
			307.00	308.00	45969	PE013991	1569	34	128	959	1050	7.19	16.82	0.67	0.45	50	0.67	10.73
			308.00	308.87	45970	PE013991	1569	54	119	1194	130	8.91	16.33	0.63	0.90	48	1.43	14.14
308.87	309.00	MAG/CR	308.87	309.00	45971	PE013991	1569	15	3536	23900	6139	38.30	3.78	0.85	25.70	465	30.24	45.06
309.00	316.86	MS	309.00	310.00	45972	PE013991	1569	15	6126	835	6583	43.98	0.15	5.45	43.60	14	8.00	8.07
			310.00	311.00	45973	PE013991	1569	319	1411	582	2523	46.89	0.18	13.10	37.30	22	2.85	3.58
			311.00	312.00	45974	PE013991	1569	42	1447	513	3084	47.25	0.05	14.10	37.10	18	2.63	3.35
			312.00	313.00	45975	PE013991	1569	5	1898	464	4164	47.07	0.06	14.80	39.30	26	2.66	3.18
			313.00	314.00	45976	PE013991	1569	113	2197	395	4262	46.03	0.08	14.20	39.90	31	2.81	3.24
			314.00	315.00	45977	PE013991	1569	269	2330	682	6822	45.94	0.05	14.60	39.70	68	2.72	3.15
			315.00	316.00	45978	PE013991	1569	1270	1748	779	4559	45.47	0.10	13.90	36.70	80	2.64	3.27
			316.00	316.86	45979	PE013991	1569	2430	3057	397	7181	44.48	0.27	9.47	36.40	74	3.84	4.70
316.86	318.60	MS	316.86	318.00	45981	PE013991	1569	3540	2477	66	6042	40.20	0.33	11.00	29.80	82	2.71	3.65
			318.00	318.60	45982	PE013991	1569	7230	2804	17	4696	42.16	0.32	11.60	29.70	85	2.56	3.63
318.60	337.00	FV/LAVA	318.60	319.00	45983	PE013991	1569	345	63	45	2196	9.80	0.83	0.28	0.83	110	2.96	35.00
			319.00	320.00	45984	PE013991	1569	60	29	23	241	7.86	1.06	0.04	0.24	67	6.00	196.50
			320.00	321.00	45985	PE013991	1569	78	32	19	434	5.21	0.77	0.02	0.23	64	11.50	260.50
			321.00	322.00	45986	PE013991	1569	27	9	24	85	5.33	0.79	0.01	0.23	60	23.00	533.00
			322.00	323.00	45987	PE013991	1569	29	2	22	675	4.33	1.20	0.01	0.19	43	19.00	433.00
			323.00	324.00	45988	PE013991	1569	161	2	17	289	3.81	0.95	0.02	0.075	31	3.75	190.50
			324.00	325.00	45989	PE013991	1569	839	11	25	104	3.43	1.15	0.07	0.074	18	1.06	49.00
			325.00	326.00	45990	PE013991	1569	325	2	7	70	1.47	0.97	0.03	0.034	9	1.13	49.00
			326.00	327.00	45992	PE013991	1569	398	6	7	424	1.13	1.79	0.03	0.053	21	1.77	37.67
			327.00	328.00	45993	PE013991	1569	1210	40	7	554	1.46	1.71	0.71	0.60	12	0.85	2.06
			328.00	329.00	45994	PE013991	1569	1540	62	116	2986	2.22	0.98	0.90	0.98	21	1.09	2.47
			329.00	330.00	45995	PE013991	1569	3230	112	7	2309	3.37	1.15	2.38	2.30	32	0.97	1.42

SILVER SWAN NICKEL PROJECT
DIAMOND DRILL LOGS

HOLE	NORTH	EAST	AMG NORTH	AMG EAST	RL	AZIMUTH GRID	AZIMUTH MAG.	DIP	LENGTH	TENEMENT
BSD059	11650.327	10264.926	6637003.853	369883.694	1365.041	270.0	234.0	-60	277.00	M27/200

AZIMUTH	DIP	DEPTH	TYPE
270.00	-59.50	0.00	EASTMAN
270.00	-58.20	34.00	EASTMAN
270.00	-59.20	64.00	EASTMAN
270.00	-60.20	87.00	EASTMAN
270.00	-61.50	126.00	EASTMAN
270.00	-61.60	159.00	EASTMAN
271.00	-63.00	189.00	EASTMAN
270.00	-63.40	219.00	EASTMAN
269.00	-64.00	271.00	EASTMAN

SD059

FROM (m)	TO (m)	LITHOLOGY	FROM (m)	TO (m)	SAMPLE NUMBER	LAB JOB NO	PX NO	As	Co	Cr	Cu	Fe %	Mg %	Ni %	S %	Zn	S:Ni	Fe:Ni
0.00	6.00	LAT																
6.00	12.00	Fe/CLAY																
12.00	18.00	SAP/FPO																
18.00	46.00	SAP/FPO																
46.00	58.00	SAP/FPO																
58.00	64.00	FPO/PW																
64.00	72.00	FPO/MLITH/BRECCIA																
72.00	74.00	FPO/PW																
74.00	90.00	FPO/MLITH/BRECCIA																
90.00	90.85	TA/CRB/PW																
90.85	93.90	TA/CRB/SW																
93.90	97.30	TA/CRB																
97.30	99.50	TA/CRB/PW																
99.50	102.60	TA/CRB																
102.60	104.10	TA/CRB/PW																
104.10	106.00	CORE LOSS																
106.00	107.00	TA/CRB/CW																
107.00	112.00	CORE LOSS																
112.00	114.70	TA/CRB/CW																
114.70	119.60	TA/CRB/PW																
119.60	126.15	TA/CRB/CW																
126.15	130.95	TA/CRB/HW																
130.95	132.65	TA/CRB																
132.65	136.60	TA/CRB/HW																
136.60	138.10	FPO																
138.10	141.20	TA/CRB/HW																
141.20	144.10	TA/CRB																
144.10	159.00	TA/CRB/HW																
159.00	164.30	TA/CRB/HW																
164.30	170.05	TA/CRB																
170.05	170.60	TA/CRB/HW																
170.60	171.80	TA/CRB																
171.80	176.35	TA/CRB/HW																
176.35	178.05	TA/CRB																
178.05	190.25	TA/CRB/CW																
190.25	191.20	TA/CRB																
191.20	196.80	TA/CRB/HW																
196.80	198.90	TA/CRB																
198.90	217.50	TA/CRB/HW																
217.50	221.00	CORE LOSS																
221.00	226.70	TA/CRB/CW																
226.70	234.10	TA/CRB/SULPH	226.70	228.00	60532	PE013878	1567	15	262	245	542	5.57	19.99	0.99	2.62	32	2.65	5.63
			228.00	229.00	60533	PE013878	1567	23	260	206	562	5.16	21.02	0.94	2.30	32	2.45	5.49
			229.00	230.00	60534	PE013878	1567	17	217	197	420	4.94	21.14	0.92	1.94	34	2.11	5.37

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BSD059 *CONTINUED*

FROM (m)	TO (m)	LITHOLOGY	FROM (m)	TO (m)	SAMPLE NUMBER	LAB JOB NO	PX NO	As	Co	Cr	Cu	Fe %	Mg %	Ni %	S %	Zn	S:Ni	Fe:Ni
			230.00	231.00	60535	PE013878	1567	17	221	207	402	4.94	20.71	0.85	1.88	37	2.21	5.81
			231.00	231.79	60536	PE013878	1567	13	207	198	360	4.88	20.78	0.79	1.96	33	2.48	6.18
			231.79	233.00	60537	PE013878	1567	14	180	237	204	3.97	20.85	0.91	1.66	34	1.82	4.36
			233.00	234.10	60539	PE013878	1567	13	193	193	305	4.66	21.10	0.84	1.61	33	1.92	5.55
234.10	239.00	TA/CRB	234.10	235.00	60540	PE013878	1567	13	200	203	465	4.78	20.80	0.96	1.69	40	1.76	4.98
			235.00	236.00	60541	PE013878	1567	13	231	148	666	5.19	20.59	1.12	1.61	47	1.44	4.63
			236.00	237.00	45926	PE013877	1566	38	239	165	709	5.71	19.15	1.31	2.30	60	1.76	4.36
			237.00	238.00	45927	PE013877	1566	16	256	182	843	5.47	19.39	1.48	2.52	76	1.70	3.70
			238.00	239.00	45928	PE013877	1566	25	297	237	1221	6.46	18.73	1.95	3.71	70	1.90	3.31
239.00	250.80	TA/CRB	239.00	240.00	45929	PE013877	1566	47	597	150	1527	7.73	16.93	3.89	8.55	52	2.20	1.99
			240.00	241.00	45930	PE013877	1566	46	557	156	1917	8.00	16.35	4.00	7.53	52	1.88	2.00
			241.00	242.00	45931	PE013877	1566	39	528	146	1905	7.89	17.70	3.56	7.03	52	1.97	2.22
			242.00	243.00	45932	PE013877	1566	33	537	219	1842	9.91	16.32	3.52	7.84	58	2.23	2.82
			243.00	244.00	45933	PE013877	1566	31	570	216	1716	10.05	16.27	3.53	6.54	78	1.85	2.85
			244.00	245.00	45934	PE013877	1566	26	515	237	1252	10.13	16.83	3.10	6.65	85	2.15	3.27
			245.00	246.00	45935	PE013877	1566	21	548	273	1286	10.19	16.35	3.46	6.95	68	2.01	2.95
			246.00	247.00	45936	PE013877	1566	20	551	210	1124	10.83	16.88	3.30	7.45	62	2.26	3.28
			247.00	248.19	45938	PE013877	1566	27	602	185	1876	10.12	16.33	3.82	8.59	61	2.25	2.65
			248.19	248.42	45939	PE013877	1566	22	432	390	2304	10.41	17.51	3.60	6.56	63	1.82	2.89
			248.42	249.28	45940	PE013877	1566	36	650	259	2231	10.71	15.55	4.68	9.49	59	2.03	2.29
			249.28	250.00	45941	PE013877	1566	18	352	222	1820	6.57	18.60	2.46	4.23	51	1.72	2.67
			250.00	250.80	45942	PE013877	1566	14	444	268	1764	7.37	17.64	3.20	5.42	55	1.69	2.30
250.80	250.97	SMS	250.80	250.97	45943	PE013877	1566	112	1902	237	4326	25.05	6.30	12.70	27.39	46	2.16	1.97
250.97	256.92	TA/CRB	250.97	251.83	45944	PE013877	1566	37	534	264	1777	8.90	16.92	3.72	7.35	62	1.98	2.39
			251.83	252.20	45945	PE013877	1566	26	370	397	1864	7.41	18.27	3.02	5.08	74	1.68	2.45
			252.20	252.44	45946	PE013877	1566	63	1133	1431	5395	15.69	12.35	8.15	15.40	167	1.89	1.93
			252.44	253.00	45947	PE013877	1566	23	283	390	1346	6.06	19.41	2.07	3.21	49	1.55	2.93
			253.00	254.00	45948	PE013877	1566	21	348	319	1209	6.29	18.21	2.49	4.00	42	1.61	2.53
			254.00	255.00	45949	PE013877	1566	24	408	367	1365	7.26	18.21	2.60	5.13	40	1.97	2.79
			255.00	256.00	45950	PE013877	1566	27	413	498	1516	7.80	17.90	2.65	5.37	55	2.03	2.94
			256.00	256.92	45951	PE013877	1566	35	359	824	1929	8.32	19.14	2.57	4.35	55	1.69	3.24
256.92	258.54	TA/CRB	256.92	257.20	45952	PE013877	1566	76	1393	387	853	15.53	11.27	15.80	20.83	37	1.32	0.98
			257.20	257.85	45953	PE013877	1566	34	344	653	2236	8.37	17.68	2.95	4.87	71	1.65	2.84
			257.85	258.06	45954	PE013877	1566	89	897	1271	1696	13.10	15.57	6.30	12.65	128	2.01	2.08
			258.06	258.54	45955	PE013877	1566	19	324	932	3156	8.15	18.14	3.76	4.38	92	1.16	2.17
258.54	259.17	SMS	258.54	259.17	45956	PE013877	1566	123	1756	460	4306	19.60	8.62	17.80	23.27	41	1.31	1.10
259.17	261.73	TA/CRB	259.17	259.40	45957	PE013877	1566	5	52	604	3265	6.40	19.05	0.78	0.95	54	1.22	8.21
			259.40	260.34	45958	PE013877	1566	5	49	675	1554	5.53	19.38	0.47	0.35	50	0.74	11.77
			260.34	260.58	45960	PE013877	1566	35	421	423	1057	6.76	18.25	5.31	5.01	35	0.94	1.27
			260.58	261.73	45961	PE013877	1566	5	40	759	273	4.86	19.29	0.32	0.078	31	0.24	15.19
261.73	263.49	TA/CRB	261.73	261.94	45962	PE013877	1566	54	663	214	3210	6.56	15.62	7.75	7.13	21	0.92	0.85
			261.94	262.62	45963	PE013877	1566	5	52	507	314	3.25	16.81	0.52	0.38	23	0.73	6.25
			262.62	263.14	45964	PE013877	1566	109	972	92	1167	7.46	14.59	9.18	9.82	12	1.07	0.81
			263.14	263.49	45965	PE013877	1566	5	116	459	200	4.59	16.36	0.85	1.19	29	1.40	5.40

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BSD059 *CONTINUED*

FROM (m)	TO (m)	LITHOLOGY	FROM (m)	TO (m)	SAMPLE NUMBER	LAB JOB NO	PX NO	As	Co	Cr	Cu	Fe %	Mg %	Ni %	S %	Zn	S:Ni	Fe:Ni
263.49	267.95	TA/CRB	263.49	264.00	45966	PE013877	1566	69	675	383	1024	6.57	14.91	5.10	6.44	22	1.26	1.29
			264.00	265.00	60542	PE013878	1567	191	89	490	46	3.68	17.85	0.33	0.33	20	1.00	11.15
			265.00	266.00	60543	PE013878	1567	282	83	512	33	3.79	19.05	0.30	0.23	27	0.77	12.63
			266.00	267.00	60544	PE013878	1567	156	81	527	27	3.70	18.12	0.22	0.12	38	0.55	16.82
			267.00	267.95	60545	PE013878	1567	816	79	461	25	3.21	15.98	0.17	0.072	34	0.42	18.88
267.95	270.35	CRB/KOM/Ooc/HAR	267.95	269.00	60546	PE013878	1567	1820	94	648	21	3.79	16.87	0.19	0.069	30	0.36	19.95
			269.00	270.35	60547	PE013878	1567	4610	145	1546	91	8.24	13.19	0.28	0.23	60	0.82	29.43
270.35	277.00	FV/LAVA	270.35	271.00	60548	PE013878	1567	2770	68	400	109	2.17	2.47	0.10	0.10	59	1.00	21.70
			271.00	272.00	60549	PE013878	1567	4250	18	32	10	0.83	0.44	0.01	0.20	13	20.00	83.00
			272.00	273.00	60551	PE013878	1567	6410	8	28	22	1.48	1.21	0.01	0.27	26	27.00	148.00
			273.00	274.00	60552	PE013878	1567	5480	15	21	78	1.53	1.01	0.01	0.25	27	25.00	153.00
			274.00	274.83	60553	PE013878	1567	6600	20	20	1017	2.81	1.56	0.01	0.49	76	49.00	281.00

SILVER SWAN NICKEL PROJECT
DIAMOND DRILL LOGS

HOLE	NORTH	EAST	AMG NORTH	AMG EAST	RL	AZIMUTH GRID	AZIMUTH MAG.	DIP	LENGTH	TENEMENT
BSD079	13199.891	10379.730	6638329.039	369073.228	1371.122	270	234	-58.0	403.00	M27/200

AZIMUTH	DIP	DEPTH	TYPE
270.00	-58.00	0.00	EASTMAN
269.50	-58.00	35.00	EASTMAN
269.00	-56.20	65.00	EASTMAN
268.80	-57.00	71.00	EASTMAN
268.00	-55.90	94.00	EASTMAN
268.50	-55.70	106.00	EASTMAN
269.00	-55.70	142.00	EASTMAN
269.00	-55.70	172.00	EASTMAN
268.00	-55.60	214.00	EASTMAN
269.00	-55.60	250.00	EASTMAN
270.50	-55.40	286.00	EASTMAN
269.00	-55.60	316.00	EASTMAN
269.00	-55.70	349.00	EASTMAN
270.50	-55.10	403.00	EASTMAN

BSD079

FROM (m)	TO (m)	LITHOLOGY	FROM (m)	TO (m)	SAMPLE NUMBER	LAB JOB NO	PX NO	As	Co	Cr	Cu	Fe %	Mg %	Ni %	S %	Zn	S:Ni	Fe:Ni
0.00	4.00	CALC																
4.00	23.00	CLAY																
23.00	36.00	SAP/CLAY																
36.00	42.00	CW/FV?																
42.00	60.00	SW/IV/MV?																
60.00	76.00	IV?																
76.00	84.00	IV																
84.00	94.00	DOL/(ALTERED)																
94.00	111.00	RHO/(SHEARED)	107.00	108.00	72195	PE017539	1774	121	192	1405	140	6.90	3.43	0.06	0.041	87	0.68	115.00
			108.00	109.00	72196	PE017539	1774	5	76	1185	122	7.85	3.71	0.04	0.87	94	21.75	196.25
			109.00	110.00	72197	PE017539	1774	5	76	1310	52	6.17	3.27	0.04	0.021	79	0.53	154.25
			110.00	111.00	72198	PE017539	1774	5	92	1261	57	8.10	4.61	0.05	0.069	87	1.38	162.00
111.00	112.20	KOM/pxSTX/oSTX	111.00	112.20	72199	PE017539	1774	25	169	2912	91	10.49	2.47	0.14	0.24	143	1.71	74.93
112.20	116.35	KOM/oSTX?	112.20	113.00	72200	PE017539	1774	40	114	3311	108	6.40	1.83	0.11	0.12	117	1.09	58.18
			113.00	114.00	72201	PE017539	1774	28	119	2869	112	8.00	2.34	0.09	0.13	98	1.44	88.89
			114.00	114.90	72202	PE017539	1774	5	120	2110	90	7.65	6.38	0.15	0.059	90	0.39	51.00
			114.90	116.35	72203	PE017539	1774	5	95	1372	59	8.48	10.58	0.16	0.071	79	0.44	53.00
116.35	119.00	KOM/oSTX?	116.35	117.00	72205	PE017539	1774	5	100	1878	48	9.04	8.91	0.15	0.065	97	0.43	60.27
			117.00	118.00	72206	PE017539	1774	5	95	2010	81	6.99	5.52	0.08	0.018	79	0.23	87.38
			118.00	119.00	72207	PE017539	1774	5	106	1970	87	8.60	6.84	0.09	0.02	86	0.22	95.56
119.00	120.00	KOM/oOC	119.00	120.00	72208	PE017539	1774	5	102	1536	31	8.23	8.99	0.13	0.057	74	0.44	63.31
120.00	133.34	KOM/oSTX/pxSTX?	120.00	121.00	72209	PE017539	1774	5	88	2039	66	8.57	8.22	0.10	0.038	93	0.38	85.70
			121.00	122.00	72210	PE017539	1774	5	98	2207	64	8.45	8.32	0.10	0.02	102	0.20	84.50
			122.00	123.00	72211	PE017539	1774	13	110	2420	42	8.26	7.68	0.11	0.021	106	0.19	75.09
			123.00	124.40	72212	PE017539	1774	5	95	2202	45	7.47	7.12	0.09	0.019	94	0.21	83.00
			124.40	125.00	72213	PE017539	1774	43	113	2133	90	8.79	8.38	0.12	0.10	89	0.83	73.25
			125.00	126.00	72214	PE017539	1774	54	128	1420	71	8.94	8.67	0.17	0.15	86	0.88	52.59
			126.00	127.00	72215	PE017539	1774	19	113	1714	46	8.73	9.07	0.15	0.15	99	1.00	58.20
			127.00	128.00	72216	PE017539	1774	14	88	3065	70	8.05	5.40	0.09	0.081	118	0.90	89.44
			128.00	129.00	72217	PE017539	1774	53	151	2088	39	9.85	6.79	0.18	0.25	128	1.39	54.72
			129.00	130.00	72218	PE017539	1774	28	104	1673	38	7.53	6.03	0.12	0.15	100	1.25	62.75
			130.00	131.00	72219	PE017539	1774	40	136	1953	25	8.30	9.13	0.19	0.11	107	0.58	43.68
			131.00	132.00	72220	PE017539	1774	20	83	1418	27	6.80	8.33	0.14	0.072	77	0.51	48.57
			132.00	133.34	72221	PE017539	1774	42	106	1423	35	7.97	9.65	0.17	0.084	70	0.49	46.88
133.34	139.97	KOM/oSTX/pxSTX?	133.34	134.00	72222	PE017539	1774	5	102	1122	9	5.33	13.06	0.20	0.024	80	0.12	26.65
			134.00	135.00	72223	PE017539	1774	29	101	1309	37	6.14	9.52	0.13	0.067	71	0.52	47.23
			135.00	136.00	72224	PE017539	1774	5	84	1229	86	7.62	8.52	0.06	0.031	70	0.52	127.00
			136.00	137.00	72225	PE017539	1774	36	102	1415	76	7.25	9.62	0.09	0.054	75	0.60	80.56
			137.00	138.00	72226	PE017539	1774	28	90	1323	29	5.97	10.61	0.12	0.057	62	0.48	49.75
			138.00	139.00	72227	PE017539	1774	95	137	1642	52	7.60	8.60	0.14	0.32	83	2.29	54.29
139.97	143.73	KOM/oSTX/pxSTX?	139.00	140.00	72228	PE017539	1774	75	136	2566	67	9.43	6.73	0.12	0.51	158	4.25	78.58
			140.00	140.66	72229	PE017539	1774	10	99	1125	231	12.50	3.82	0.07	3.20	530	45.71	178.57
			140.66	141.00	72230	PE017539	1774	149	135	1788	177	10.30	5.07	0.10	0.45	133	4.50	103.00
			141.00	142.00	72231	PE017539	1774	167	132	2814	63	9.76	6.94	0.13	0.40	144	3.08	75.08

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BSD079 *CONTINUED*

FROM (m)	TO (m)	LITHOLOGY	FROM (m)	TO (m)	SAMPLE NUMBER	LAB JOB NO	PX NO	As	Co	Cr	Cu	Fe %	Mg %	Ni %	S %	Zn	S:Ni	Fe:Ni
			142.00	143.00	72232	PE017539	1774	170	125	1408	49	8.63	6.35	0.14	0.40	107	2.86	61.64
143.73	157.00	CRB/KOM/SPX/SHEAR	143.00	144.00	72233	PE017539	1774	104	92	1049	50	8.27	4.02	0.05	0.095	99	1.90	165.40
157.00	190.00	TA/CRB	157.30	158.00	72571	PE018448	1783	12	98	1636	98	7.64	14.85	0.09	0.067	115	0.74	84.89
			158.00	159.00	72572	PE018448	1783	5	99	1330	41	7.52	15.40	0.11	0.029	98	0.26	68.36
			159.00	160.00	72573	PE018448	1783	5	95	1247	43	5.74	15.14	0.14	0.029	55	0.21	41.00
			160.00	161.00	72574	PE018448	1783	10	109	1257	50	6.14	15.49	0.13	0.80	53	6.15	47.23
			161.00	162.00	72575	PE018448	1783	5	101	971	32	5.75	16.58	0.16	1.08	49	6.75	35.94
			162.00	163.00	72576	PE018448	1783	5	97	758	41	5.07	16.87	0.15	0.28	45	1.87	33.80
			163.00	164.00	72577	PE018448	1783	5	109	958	25	5.32	18.31	0.17	0.25	42	1.47	31.29
			164.00	165.00	72578	PE018448	1783	5	105	1086	35	5.12	18.22	0.18	0.13	44	0.72	28.44
			165.00	166.00	72579	PE018448	1783	5	105	1022	27	5.51	18.31	0.18	0.055	44	0.31	30.61
			166.00	167.00	72580	PE018448	1783	5	103	1019	16	5.60	18.97	0.18	0.019	46	0.11	31.11
			167.00	168.00	72581	PE018448	1783	5	104	1132	21	5.80	18.98	0.18	0.021	50	0.12	32.22
			168.00	169.00	72582	PE018448	1783	5	106	1158	36	5.63	18.92	0.18	0.019	50	0.11	31.28
190.00	193.43	FPO																
193.43	196.75	CRB/TA																
196.75	222.60	RHO (PORP)/SHEAR																
222.60	269.98	MICRO SXN																
269.98	273.31	FPO																
273.31	305.15	TA/CRB																
305.15	306.70	FI																
306.70	313.30	TA/CRB																
313.30	314.00	CHL/LAMP																
314.00	330.00	TA/CRB																
330.00	330.60	CHL/LAMP																
330.60	373.82	TA/CRB	355.00	356.00	72234	PE017539	1774	5	94	511	2	3.42	21.86	0.22	0.012	24	0.05	15.55
			356.00	357.00	72235	PE017539	1774	5	102	575	2	3.59	21.47	0.25	0.013	25	0.05	14.36
			357.00	358.00	72236	PE017539	1774	5	98	554	2	3.28	21.34	0.24	0.01	29	0.04	13.67
			358.00	359.00	72237	PE017539	1774	5	106	583	2	3.39	22.09	0.24	0.014	28	0.06	14.13
			359.00	360.00	72238	PE017539	1774	5	109	515	2	3.23	21.98	0.25	0.012	25	0.05	12.92
			360.00	361.00	72239	PE017539	1774	5	109	1622	2	3.45	21.49	0.25	0.012	46	0.05	13.80
			361.00	362.00	72240	PE017539	1774	5	100	2400	27	3.38	21.71	0.21	0.013	40	0.06	16.10
			362.00	363.00	72241	PE017539	1774	5	105	2265	2	3.43	21.17	0.22	0.013	31	0.06	15.59
			363.00	364.00	72242	PE017539	1774	5	104	2942	2	3.75	21.30	0.22	0.014	40	0.06	17.05
			364.00	365.00	72243	PE017539	1774	5	114	2854	4	4.47	22.56	0.21	0.013	36	0.06	21.29
			365.00	366.00	72244	PE017539	1774	5	106	2639	28	4.24	20.59	0.21	0.011	40	0.05	20.19
			366.00	367.00	72245	PE017539	1774	5	107	2564	2	3.96	19.62	0.21	0.013	41	0.06	18.86
			367.00	368.00	72246	PE017539	1774	5	111	3188	2	4.05	20.77	0.21	0.011	49	0.05	19.29
			368.00	369.00	72247	PE017539	1774	5	106	2010	2	3.93	20.64	0.19	0.011	38	0.06	20.68
			369.00	370.00	72248	PE017539	1774	5	108	1565	2	3.87	20.30	0.16	0.011	26	0.07	24.19
			370.00	371.00	72249	PE017539	1774	5	97	1399	2	4.25	20.19	0.19	0.011	35	0.06	22.37
			371.00	372.00	72250	PE017539	1774	5	96	2247	2	4.39	20.10	0.19	0.017	41	0.09	23.11
			372.00	373.00	72251	PE017539	1774	5	106	1798	9	5.12	19.90	0.19	0.035	46	0.18	26.95
373.82	375.20	SHEAR/CHL/MV	373.00	373.86	72252	PE017539	1774	5	91	1084	26	4.40	17.55	0.20	0.15	38	0.75	22.00

CONTINUED...

BSD079 *CONTINUED*

FROM (m)	TO (m)	LITHOLOGY	FROM (m)	TO (m)	SAMPLE NUMBER	LAB JOB NO	PX NO	As	Co	Cr	Cu	Fe %	Mg %	Ni %	S %	Zn	S:Ni	Fe:Ni
			373.86	375.00	72254	PE017539	1774	20	66	1097	36	6.44	11.77	0.09	0.30	84	3.33	71.56
375.20	403.00	FI?	375.00	376.00	72255	PE017539	1774	5	21	214	32	3.48	3.50	0.02	0.32	72	16.00	174.00
			376.00	377.00	72256	PE017539	1774	26	17	52	39	3.37	2.11	0.01	1.00	468	100.00	337.00
			377.00	378.00	72257	PE017539	1774	5	15	56	27	3.48	2.38	0.01	0.64	88	64.00	348.00
			378.00	379.00	72258	PE017539	1774	29	19	15	61	3.63	1.52	0.00	1.65	65		
			379.00	380.00	72259	PE017539	1774	23	21	18	67	3.38	1.52	0.00	1.71	69		
			380.00	381.00	72260	PE017539	1774	16	19	23	59	2.45	1.00	0.00	1.84	74		
			381.00	382.00	72261	PE017539	1774	10	17	34	50	3.81	2.09	0.00	1.83	68		
			382.00	383.00	72262	PE017539	1774	5	29	260	27	2.49	3.02	0.03	0.54	62	18.00	83.00
			383.00	384.00	72263	PE017539	1774	12	10	35	27	2.35	1.31	0.00	0.70	53		
			384.00	385.00	72264	PE017539	1774	14	12	33	33	2.48	1.39	0.00	0.65	46		

SILVER SWAN NICKEL PROJECT
DIAMOND DRILL LOGS

HOLE	NORTH	EAST	AMG NORTH	AMG EAST	RL	AZIMUTH GRID	AZIMUTH MAG.	DIP	LENGTH	TENEMENT
BSD082	11250	10578	6636861.381	370371.375	1364.50	270	234	-65	760	

AZIMUTH	DIP	DEPTH	TYPE
270.00	-65.00	0.00	EASTMAN
269.00	-64.80	35.00	EASTMAN
268.00	-64.30	62.00	EASTMAN
267.70	-64.30	68.00	EASTMAN
267.20	-64.50	79.00	EASTMAN
267.00	-64.50	81.00	EASTMAN
267.00	-64.20	121.00	EASTMAN
269.00	-64.20	151.00	EASTMAN
271.00	-64.00	181.00	EASTMAN
270.00	-63.90	211.00	EASTMAN
271.00	-63.90	241.00	EASTMAN
272.00	-63.40	271.00	EASTMAN
273.00	-63.00	301.00	EASTMAN
274.00	-63.00	331.00	EASTMAN
272.00	-62.70	361.00	EASTMAN
273.80	-62.30	391.00	EASTMAN
273.00	-62.00	421.00	EASTMAN
273.50	-62.00	457.00	EASTMAN
274.00	-61.60	490.00	EASTMAN
273.90	-61.30	520.00	EASTMAN
274.00	-61.00	550.00	EASTMAN
273.50	-60.70	580.00	EASTMAN
273.90	-60.00	616.00	EASTMAN
274.10	-60.00	646.00	EASTMAN
274.00	-59.80	676.00	EASTMAN
274.50	-59.50	706.00	EASTMAN
276.50	-59.20	736.00	EASTMAN
277.00	-59.00	760.00	EASTMAN

BSD082

FROM (m)	TO (m)	LITHOLOGY	FROM (m)	TO (m)	SAMPLE NUMBER	LAB JOB NO	PX NO	As	Co	Cr	Cu	Fe %	Mg %	Ni %	S %	Zn	S:Ni	Fe:Ni
0.00	5.00	SIL																
5.00	13.00	SAP/(F?)																
13.00	17.00	SAP/CLAY																
17.00	22.00	SAP																
22.00	43.00	SAP/TA/CRB																
43.00	63.00	CW/TA/CRB																
63.00	81.00	TA/CRB																
81.00	123.93	CRB/TA																
123.93	152.61	TA/CRB																
152.61	175.47	CRB/TA																
175.47	229.18	TA/CRB																
229.18	280.35	SERP																
280.35	367.00	TA/CRB																
367.00	403.00	CRB/TA																
403.00	448.00	TA/CRB	447.00	448.00	72452	PE018449	1784	5	81	534	11	3.73	18.50	0.21	0.002	18	0.01	17.76
448.00	529.00	TA/CRB/SULPH	448.00	449.00	72453	PE018449	1784	5	81	598	12	3.83	19.38	0.24	0.002	20	0.01	15.96
			449.00	450.00	72454	PE018449	1784	23	121	579	108	4.24	18.50	1.67	0.68	19	0.41	2.54
			450.00	451.00	72455	PE018449	1784	21	158	903	177	4.52	18.38	2.67	1.52	32	0.57	1.69
			451.00	452.00	72456	PE018449	1784	24	144	675	225	4.71	18.68	2.71	1.68	22	0.62	1.74
			452.00	453.00	72457	PE018449	1784	17	90	613	86	4.16	18.55	0.72	0.20	28	0.28	5.78
			453.00	454.00	72458	PE018449	1784	5	67	573	260	4.13	18.67	0.50	0.07	22	0.14	8.26
			454.00	455.00	72459	PE018449	1784	12	121	607	425	3.76	17.92	1.44	0.80	20	0.56	2.61
			455.00	456.00	72460	PE018449	1784	19	121	489	170	4.10	20.30	1.42	0.75	19	0.53	2.89
			456.00	457.00	72461	PE018449	1784	20	96	533	59	4.18	20.50	0.59	0.16	21	0.27	7.08
			457.00	458.00	72462	PE018449	1784	22	95	598	33	4.34	20.20	0.36	0.016	21	0.04	12.06
			458.00	459.00	72463	PE018449	1784	11	80	589	9	4.06	19.24	0.30	0.01	30	0.03	13.53
			459.00	460.00	72464	PE018449	1784	15	84	576	26	4.14	20.70	0.31	0.01	20	0.03	13.35
			460.00	461.00	72465	PE018449	1784	17	121	548	82	4.06	19.98	1.16	0.45	22	0.39	3.50
			461.00	462.00	72466	PE018449	1784	14	83	504	19	4.07	20.10	0.39	0.033	32	0.08	10.44
			462.00	463.00	72467	PE018449	1784	19	92	510	24	3.86	20.50	0.43	0.025	25	0.06	8.98
			463.00	464.00	72469	PE018449	1784	21	94	480	30	3.74	20.62	0.45	0.038	21	0.08	8.31
			464.00	465.00	72470	PE018449	1784	16	82	500	42	4.14	21.40	0.42	0.022	24	0.05	9.86
			465.00	466.00	72471	PE018449	1784	14	97	508	473	4.39	21.31	0.90	0.35	26	0.39	4.88
			466.00	467.00	72472	PE018449	1784	18	146	536	879	4.19	20.09	2.04	1.27	26	0.62	2.05
			467.00	468.00	72473	PE018449	1784	18	132	556	471	4.26	20.82	1.67	0.87	18	0.52	2.55
			468.00	469.00	72474	PE018449	1784	13	141	437	1170	3.92	16.46	2.46	1.63	20	0.66	1.59
			469.00	470.00	72475	PE018449	1784	11	82	552	414	4.49	19.17	0.84	0.29	30	0.35	5.35
			470.00	471.00	72476	PE018449	1784	12	132	512	436	4.28	20.51	1.32	0.67	22	0.51	3.24
			471.00	472.00	72477	PE018449	1784	5	87	440	285	3.77	20.50	0.57	0.18	17	0.32	6.61
			472.00	473.00	72478	PE018449	1784	11	120	430	306	3.80	20.50	0.75	0.32	17	0.43	5.07
			473.00	474.00	72479	PE018449	1784	16	86	475	140	4.06	21.81	0.39	0.039	17	0.10	10.41
			474.00	475.00	72480	PE018449	1784	16	89	499	67	4.02	21.56	0.40	0.068	20	0.17	10.05
			475.00	476.00	72481	PE018449	1784	11	97	558	50	3.92	21.98	0.42	0.10	22	0.24	9.33
			476.00	477.00	72482	PE018449	1784	5	110	551	74	3.89	21.48	0.57	0.19	23	0.33	6.82

CONTINUED...

BSD082 *CONTINUED*

FROM (m)	TO (m)	LITHOLOGY	FROM (m)	TO (m)	SAMPLE NUMBER	LAB JOB NO	PX NO	As	Co	Cr	Cu	Fe %	Mg %	Ni %	S %	Zn	S:Ni	Fe:Ni
			477.00	478.00	72483	PE018449	1784	5	85	550	39	3.86	21.33	0.36	0.31	24	0.86	10.72
			478.00	479.00	72484	PE018449	1784	5	94	515	31	3.97	21.99	0.39	0.30	21	0.77	10.18
			479.00	480.00	72485	PE018449	1784	22	94	508	29	3.97	21.94	0.40	0.086	24	0.22	9.93
			480.00	481.00	72486	PE018449	1784	21	98	498	24	3.97	21.86	0.41	0.072	22	0.18	9.68
			481.00	482.00	72487	PE018449	1784	24	89	420	25	3.75	21.58	0.41	0.07	21	0.17	9.15
			482.00	483.00	72488	PE018449	1784	15	89	426	35	3.99	20.99	0.37	0.08	21	0.22	10.78
			483.00	484.00	72489	PE018449	1784	17	88	469	22	3.67	21.27	0.37	0.037	24	0.10	9.92
			484.00	485.00	72490	PE018449	1784	11	90	468	16	4.02	20.93	0.36	0.064	23	0.18	11.17
			485.00	486.00	72491	PE018449	1784	20	94	476	21	3.79	21.84	0.37	0.05	19	0.14	10.24
			486.00	487.00	72492	PE018449	1784	11	86	538	18	3.63	21.28	0.36	0.10	24	0.28	10.08
			487.00	488.00	72493	PE018449	1784	11	87	463	17	3.94	21.11	0.34	0.12	22	0.35	11.5
			488.00	489.00	72494	PE018449	1784	19	93	460	16	3.75	21.91	0.33	0.053	18	0.16	11.3
			489.00	490.00	72495	PE018449	1784	16	102	424	14	3.82	21.27	0.29	0.097	19	0.33	13.1
			490.00	491.00	72496	PE018449	1784	17	94	464	17	3.74	21.34	0.28	0.099	18	0.35	13.3
			491.00	492.00	72497	PE018449	1784	16	93	493	19	3.66	21.46	0.30	0.072	17	0.24	12.2
			492.00	493.00	72498	PE018449	1784	16	100	476	19	3.62	21.28	0.27	0.17	22	0.63	13.4
			493.00	494.00	72499	PE018449	1784	5	90	541	25	3.59	21.75	0.26	0.069	16	0.27	13.8
			494.00	495.00	72501	PE018449	1784	15	105	536	18	3.65	19.31	0.23	0.069	35	0.30	15.8
			495.00	496.00	72502	PE018449	1784	5	97	407	34	3.44	20.30	0.28	0.047	20	0.17	12.2
			496.00	497.00	72503	PE018449	1784	10	102	434	37	3.53	20.98	0.29	0.071	20	0.24	12.1
			497.00	498.00	72504	PE018449	1784	10	100	431	72	3.70	20.88	0.46	0.46	22	1.00	8.04
			498.00	499.00	72505	PE018449	1784	5	76	494	83	3.84	21.39	0.31	0.063	17	0.20	12.3
			499.00	500.00	72506	PE018449	1784	5	131	444	101	3.64	21.60	0.55	0.30	23	0.55	6.62
			500.00	501.00	72507	PE018449	1784	5	104	649	245	3.97	20.91	0.53	0.28	17	0.53	7.49
			501.00	502.00	72508	PE018449	1784	18	258	670	382	5.26	19.23	0.60	1.86	30	3.10	8.77
			502.00	503.00	72509	PE018449	1784	5	166	583	266	4.69	18.44	0.52	0.61	40	1.17	9.02
			503.00	504.00	72510	PE018449	1784	5	200	651	409	5.17	16.61	1.00	0.99	32	0.99	5.17
			504.00	505.00	72511	PE018449	1784	66	214	673	404	5.56	17.57	0.83	1.66	28	2.00	6.70
			505.00	506.00	72512	PE018449	1784	77	213	793	425	5.35	17.34	0.73	1.21	35	1.66	7.33
			506.00	507.00	72513	PE018449	1784	81	221	663	346	5.16	18.03	1.22	1.52	29	1.25	4.23
			507.00	508.00	72514	PE018449	1784	26	199	592	467	4.73	18.88	1.24	1.05	37	0.85	3.81
			508.00	509.00	72515	PE018449	1784	42	179	580	354	4.93	17.93	0.95	1.03	33	1.08	5.19
			509.00	510.00	72516	PE018449	1784	41	166	643	224	4.79	18.86	0.77	0.98	27	1.27	6.22
			510.00	511.00	72517	PE018449	1784	27	127	637	135	4.31	19.55	0.44	0.54	26	1.23	9.80
			511.00	512.00	72518	PE018449	1784	22	147	605	171	4.42	18.11	0.74	1.10	26	1.49	5.97
			512.00	513.00	72519	PE018449	1784	22	128	649	178	4.47	18.64	0.50	0.76	20	1.52	8.94
			513.00	514.00	72520	PE018449	1784	14	117	694	100	4.04	19.39	0.40	0.49	39	1.23	10.1
			514.00	515.00	72521	PE018449	1784	36	190	637	213	5.15	18.31	0.76	1.19	16	1.57	6.78
			515.00	516.00	72522	PE018449	1784	27	166	540	163	4.73	18.35	0.46	0.53	12	1.15	10.2
			516.00	517.00	72523	PE018449	1784	51	239	700	288	5.60	18.31	0.76	1.38	15	1.82	7.37
			517.00	518.00	72524	PE018449	1784	19	262	746	375	5.54	17.38	0.94	1.24	16	1.32	5.8
			518.00	519.00	72525	PE018449	1784	5	184	652	198	4.88	18.05	0.59	0.64	19	1.08	8.27
			519.00	520.00	72526	PE018449	1784	5	109	669	136	4.32	18.58	0.24	0.10	17	0.42	18.0
			520.00	521.00	72527	PE018449	1784	5	153	739	175	4.84	19.39	0.48	0.27	14	0.56	10.0

CONTINUE

BSD082 *CONTINUED*

FROM (m)	TO (m)	LITHOLOGY	FROM (m)	TO (m)	SAMPLE NUMBER	LAB JOB NO	PX NO	As	Co	Cr	Cu	Fe %	Mg %	Ni %	S %	Zn	S:Ni	Fe:Ni
			521.00	522.00	72528	PE018449	1784	5	153	759	210	4.63	19.70	0.53	0.31	17	0.58	8.74
			522.00	523.00	72529	PE018449	1784	10	148	707	214	4.38	19.97	0.47	0.25	18	0.53	9.32
			523.00	524.00	72530	PE018449	1784	5	126	507	149	3.85	19.61	0.46	0.19	69	0.41	8.37
			524.00	525.00	72532	PE018449	1784	5	112	558	63	3.86	19.81	0.37	0.089	13	0.24	10.43
			525.00	526.00	72533	PE018449	1784	17	134	557	196	4.18	19.88	0.52	0.20	17	0.38	8.04
			526.00	527.00	72534	PE018449	1784	5	108	557	156	3.93	18.13	0.68	0.36	15	0.53	5.78
			527.00	528.00	72535	PE018449	1784	5	110	547	36	3.49	19.40	0.39	0.084	17	0.22	8.95
			528.00	529.00	72536	PE018449	1784	11	95	551	14	3.37	21.04	0.27	0.022	17	0.08	12.48
529.00	551.43	CRB/TA	529.00	530.00	72537	PE018449	1784	5	93	560	7	3.33	20.18	0.25	0.034	19	0.14	13.32
			530.00	531.00	72538	PE018449	1784	5	80	411	27	2.95	18.22	0.18	0.043	16	0.24	16.39
			531.00	532.00	72539	PE018449	1784	5	98	535	7	3.47	20.09	0.21	0.087	16	0.41	16.52
551.43	566.02	TA/CRB	556.00	557.00	72540	PE018449	1784	16	130	493	107	3.95	19.29	0.41	0.11	25	0.27	9.63
			557.00	558.00	72541	PE018449	1784	21	177	547	405	4.22	18.97	0.61	0.19	24	0.31	6.92
			558.00	559.00	72542	PE018449	1784	5	121	527	83	4.37	20.70	0.37	0.021	22	0.06	11.81
			559.00	560.00	72543	PE018449	1784	5	114	522	129	4.37	19.80	0.43	0.061	21	0.14	10.16
			560.00	561.00	72544	PE018449	1784	14	154	557	93	4.30	19.70	0.55	0.075	23	0.14	7.82
			561.00	562.00	72545	PE018449	1784	5	128	479	88	3.98	18.85	0.28	0.06	24	0.21	14.21
566.02	568.36	FI																
568.36	687.30	TA/CRB																
687.30	692.00	FPO																
692.00	733.49	CRB/TA	712.00	713.00	72547	PE018449	1784	5	105	604	84	4.03	18.19	0.19	0.017	21	0.09	21.21
			713.00	714.00	72548	PE018449	1784	5	101	474	8	3.78	17.96	0.18	0.042	19	0.23	21.00
			714.00	715.00	72549	PE018449	1784	5	82	450	6	3.25	16.42	0.18	0.035	25	0.19	18.06
			715.00	716.00	72550	PE018449	1784	5	83	446	91	3.40	15.64	0.17	0.024	24	0.14	20.00
			716.00	717.00	72551	PE018449	1784	5	90	594	7	3.58	17.50	0.18	0.01	19	0.06	19.89
			717.00	718.00	72552	PE018449	1784	5	112	615	5	3.44	18.40	0.19	0.022	19	0.12	18.11
			718.00	719.00	72553	PE018449	1784	5	121	602	6	3.50	19.21	0.20	0.006	19	0.03	17.50
			719.00	720.00	72554	PE018449	1784	5	121	544	18	3.61	18.67	0.19	0.057	18	0.30	19.00
			720.00	721.00	72555	PE018449	1784	5	118	554	42	3.68	18.26	0.19	0.092	14	0.48	19.37
			721.00	722.00	72556	PE018449	1784	5	115	535	15	3.30	19.00	0.20	0.031	20	0.16	16.50
			722.00	723.00	72557	PE018449	1784	5	114	422	7	3.16	19.41	0.19	0.005	21	0.03	16.63
			723.00	724.00	72558	PE018449	1784	5	96	601	9	3.20	20.00	0.22	0.006	19	0.03	14.55
			724.00	725.00	72559	PE018449	1784	5	94	744	17	3.33	19.43	0.19	0.007	27	0.04	17.53
			725.00	726.00	72560	PE018449	1784	5	92	564	28	3.07	19.09	0.20	0.005	23	0.03	15.35
			726.00	727.00	72561	PE018449	1784	5	98	570	11	2.89	19.09	0.21	0.007	20	0.03	13.76
			727.00	728.00	72562	PE018449	1784	5	95	527	6	3.21	18.63	0.20	0.008	18	0.04	16.05
			728.00	729.00	72563	PE018449	1784	5	92	522	19	3.55	18.08	0.19	0.016	16	0.08	18.68
			729.00	730.00	72564	PE018449	1784	5	95	542	26	3.80	18.18	0.19	0.007	20	0.04	20.0
			730.00	731.00	72565	PE018449	1784	5	100	527	6	3.96	18.65	0.20	0.015	22	0.08	19.8
			731.00	732.00	72566	PE018449	1784	5	97	541	32	3.83	18.39	0.19	0.01	24	0.05	20.1
733.49	760.00	FV	732.00	733.55	72567	PE018449	1784	20	126	738	41	4.30	15.00	0.20	0.35	32	1.75	21.5
			733.55	735.00	72568	PE018449	1784	20	73	48	32	1.75	1.91	0.01	0.012	44	1.20	175.
			735.00	736.00	72569	PE018449	1784	80	109	41	59	1.43	1.35	0.01	0.015	31	1.50	143.

SILVER SWAN NICKEL PROJECT
DIAMOND DRILL LOGS

HOLE	NORTH	EAST	AMG NORTH	AMG EAST	RL	AZIMUTH GRID	AZIMUTH MAG.	DIP	LENGTH	TENEMENT
BSD086	10849.80	10599.66	6636549.059	370622.360	1361.56	270	234	-66	457	

AZIMUTH	DIP	DEPTH	TYPE
270.00	-66.00	0.00	EASTMAN
269.00	-65.70	35.00	EASTMAN
267.50	-66.00	65.00	EASTMAN
266.00	-66.80	83.00	EASTMAN
264.50	-66.70	94.00	EASTMAN
265.30	-66.40	124.00	EASTMAN
265.00	-66.40	157.00	EASTMAN
267.30	-66.20	187.00	EASTMAN
268.00	-66.40	199.00	EASTMAN
273.90	-66.00	203.50	EASTMAN
274.00	-66.10	209.00	EASTMAN
272.80	-66.80	238.00	EASTMAN
272.80	-66.90	262.00	EASTMAN
272.80	-67.10	289.00	EASTMAN
273.00	-67.10	319.00	EASTMAN
273.00	-67.10	349.00	EASTMAN
273.50	-67.10	379.00	EASTMAN
274.10	-67.10	409.00	EASTMAN
275.50	-67.00	457.00	EASTMAN

BSD086

FROM (m)	TO (m)	LITHOLOGY	FROM (m)	TO (m)	SAMPLE NUMBER	LAB JOB NO	PX NO	As	Co	Cr	Cu	Fe %	Mg %	Ni %	S %	Zn	S:Ni	Fe:Ni
0.00	9.00	LAT																
9.00	22.00	Fe/CLAY																
22.00	27.00	CLAY																
27.00	36.00	SAP/CLAY																
36.00	40.00	QTZ																
40.00	66.00	SAP/TA/CRB																
66.00	69.00	SW/TA/CRB																
69.00	84.00	TA/CRB																
84.00	85.90	TA/CRB																
85.90	91.04	KOM/oSTX																
91.04	106.10	TA/CRB	94.00	95.00	72846	PE019034	1791	5	82	961	10	5.57	14.95	0.14	0.002	29	0.01	39.79
			95.00	96.00	72847	PE019034	1791	5	83	863	12	4.73	16.02	0.19	0.002	26	0.01	24.89
			96.00	97.00	72848	PE019034	1791	5	83	778	14	4.67	17.33	0.21	0.002	26	0.01	22.24
			97.00	98.00	72849	PE019034	1791	5	90	866	16	4.77	16.88	0.22	0.002	31	0.01	21.68
			98.00	99.00	72850	PE019034	1791	5	94	1610	100	6.24	14.95	0.12	0.002	56	0.02	52.00
			99.00	100.00	72851	PE019034	1791	12	100	1787	244	6.76	14.75	0.10	0.002	66	0.02	67.60
			100.00	101.00	72852	PE019034	1791	5	90	1641	154	7.20	14.42	0.10	0.002	70	0.02	72.00
			101.00	102.00	72853	PE019034	1791	5	114	1659	32	7.05	14.12	0.09	0.002	53	0.02	78.33
			102.00	103.00	72854	PE019034	1791	5	111	2808	68	6.00	15.12	0.15	0.002	51	0.01	40.00
			103.00	104.00	72855	PE019034	1791	5	81	791	30	4.84	15.71	0.17	0.02	30	0.12	28.47
			104.00	105.00	72856	PE019034	1791	5	77	583	22	4.48	15.36	0.18	0.03	24	0.17	24.89
			105.00	106.10	72857	PE019034	1791	5	73	773	23	4.20	13.30	0.16	0.113	30	0.71	26.25
106.10	123.87	TA/CRB/oSTX	106.10	107.00	72859	PE019034	1791	5	90	1767	24	6.96	13.04	0.12	0.006	63	0.05	58.00
			107.00	108.00	72860	PE019034	1791	5	77	1130	25	4.80	12.56	0.14	0.017	47	0.12	34.29
			108.00	109.00	72861	PE019034	1791	5	79	1121	26	4.74	12.20	0.15	0.022	48	0.15	31.60
			109.00	110.00	72862	PE019034	1791	5	79	1400	50	5.88	11.50	0.11	0.04	65	0.36	53.45
			110.00	111.00	72863	PE019034	1791	5	108	2724	93	7.58	7.46	0.12	0.48	88	4.00	63.17
			111.00	112.00	72864	PE019034	1791	41	146	2630	94	8.80	7.46	0.20	0.78	122	3.90	44.00
			112.00	113.00	72865	PE019034	1791	20	134	3140	102	7.98	6.32	0.14	0.074	129	0.53	57.00
			113.00	114.00	72866	PE019034	1791	5	80	2939	112	7.35	5.30	0.09	0.06	191	0.67	81.67
			114.00	115.00	72867	PE019034	1791	49	139	2868	97	12.77	6.16	0.19	0.28	161	1.47	67.21
			115.00	116.00	72868	PE019034	1791	34	168	3103	67	13.95	6.74	0.26	0.17	181	0.65	53.65
			116.00	117.00	72869	PE019034	1791	14	131	3482	126	10.53	4.85	0.16	0.07	244	0.44	65.81
			117.00	118.00	72870	PE019034	1791	29	123	3400	107	9.62	2.75	0.12	0.25	207	2.08	80.17
			118.00	119.00	72871	PE019034	1791	25	219	3309	115	6.58	3.26	0.13	0.04	181	0.31	50.62
			119.00	120.00	72872	PE019034	1791	136	245	3293	107	5.73	2.56	0.13	0.18	138	1.38	44.08
			120.00	121.00	72873	PE019034	1791	11	135	2682	62	11.85	5.50	0.19	0.32	169	1.68	62.37
			121.00	121.42	72874	PE019034	1791	37	182	1075	200	18.44	6.72	0.17	13.60	110	80.00	108.
			121.42	123.00	72875	PE019034	1791	88	77	2724	102	7.02	4.38	0.10	0.29	213	2.90	70.2
			123.00	123.87	72876	PE019034	1791	101	107	2129	95	19.51	5.06	0.14	0.89	245	6.36	139.
123.87	143.80	FV/SULPH	123.87	125.00	72877	PE019034	1791	5	15	79	21	8.45	1.96	0.03	0.18	90	6.00	281.
			125.00	126.00	72878	PE019034	1791	5	24	49	53	10.47	2.51	0.02	0.23	62	11.50	523.
			126.00	127.00	72879	PE019034	1791	5	30	30	27	14.01	3.13	0.02	0.10	81	5.00	700.
			127.00	128.00	72880	PE019034	1791	5	18	30	22	12.10	2.50	0.02	0.17	97	8.50	605.

CONTINUE

BSD086 *CONTINUED*

FROM (m)	TO (m)	LITHOLOGY	FROM (m)	TO (m)	SAMPLE NUMBER	LAB JOB NO	PX NO	As	Co	Cr	Cu	Fe %	Mg %	Ni %	S %	Zn	S:Ni	Fe:Ni
			128.00	129.00	72881	PE019034	1791	14	75	33	15	6.15	1.35	0.03	0.11	82	3.67	205.0
			129.00	130.00	72882	PE019034	1791	14	51	28	24	5.64	1.35	0.03	0.18	78	6.00	188.0
143.80	147.27	KOM																
147.27	166.10	FV/DULPH																
166.10	173.20	KOM/FV																
173.20	182.00	FV/SULPH																
182.00	183.80	KOM/FV																
183.80	193.00	KOM/oSTX																
193.00	199.00	CRB/TA																
199.00	203.50	NAVI DRILL																
203.50	207.55	TA/CRB/oSTX																
207.55	210.80	FV/KOM																
210.80	313.00	TA/CRB																
313.00	319.00	SHEAR/TA/CRB																
319.00	352.80	TA/CRB																
352.80	354.84	SHEAR/TA/CRB																
354.84	378.22	AND DYKE																
378.22	401.27	TA/CRB	385.00	386.00	72884	PE019034	1791	5	114	769	19	4.83	18.64	0.24	0.008	41	0.03	20.1
			386.00	387.00	72885	PE019034	1791	5	104	843	9	4.80	18.34	0.24	0.01	40	0.04	20.0
			387.00	388.00	72886	PE019034	1791	5	101	746	12	4.59	17.92	0.23	0.02	42	0.09	19.9
			388.00	389.00	72887	PE019034	1791	5	111	811	15	5.05	19.30	0.24	0.007	42	0.03	21.0
			389.00	390.00	72888	PE019034	1791	5	102	858	17	4.90	18.91	0.24	0.005	44	0.02	20.4
			390.00	391.00	72889	PE019034	1791	5	100	767	47	4.36	17.58	0.22	0.009	41	0.04	19.8
			391.00	392.00	72890	PE019034	1791	5	92	653	20	4.23	18.11	0.22	0.008	40	0.04	19.2
			392.00	393.00	72891	PE019034	1791	5	107	790	11	4.79	18.61	0.25	0.08	36	0.32	19.1
			393.00	394.00	72892	PE019034	1791	5	87	741	20	4.50	17.04	0.20	0.005	37	0.03	22.5
			394.00	395.00	72893	PE019034	1791	5	97	835	22	4.73	17.79	0.23	0.007	45	0.03	20.5
			395.00	396.00	72894	PE019034	1791	22	110	1007	72	4.80	15.17	0.22	0.53	50	2.41	21.8
			396.00	397.00	72895	PE019034	1791	28	97	1236	31	5.13	16.75	0.22	0.012	53	0.05	23.3
			397.00	398.00	72896	PE019034	1791	50	95	813	26	5.09	16.41	0.22	0.009	42	0.04	23.1
			398.00	399.00	72897	PE019034	1791	156	91	858	30	4.53	13.87	0.19	0.011	38	0.06	23.8
			399.00	400.00	72898	PE019034	1791	637	93	1077	31	4.76	11.83	0.18	0.04	46	0.22	26.4
401.27	457.00	FV	400.00	401.30	72899	PE019034	1791	655	119	1921	48	7.84	9.23	0.18	0.08	110	0.44	43.5
			401.30	402.00	72900	PE019034	1791	60	27	89	39	2.02	0.83	0.02	0.011	52	0.55	101.
			402.00	403.00	76001	PE019034	1791	14	9	28	32	1.78	0.67	0.01	0.05	43	5.00	178.
			403.00	404.00	76002	PE019034	1791	5	9	18	20	2.77	1.03	0.01	0.14	57	14.00	277.
			404.00	405.00	76003	PE019034	1791	10	13	7	5	2.90	0.94	0.01	0.006	55	0.60	290.
			405.00	406.00	76004	PE019034	1791	20	12	7	7	1.69	0.46	0.01	0.013	37	1.30	169.

SILVER SWAN NICKEL PROJECT
DIAMOND DRILL LOGS

HOLE	NORTH	EAST	AMG NORTH	AMG EAST	RL	AZIMUTH GRID	AZIMUTH MAG.	DIP	LENGTH	TENEMENT
BSD088	20000	20190	6636212.140	370675.600	1360.52	270	270	-70	366.5	

AZIMUTH	DIP	DEPTH	TYPE
270.00	-70.00	0.00	EASTMAN
269.00	-69.00	35.00	EASTMAN
268.00	-69.30	65.00	EASTMAN
266.50	-69.30	91.00	EASTMAN
267.80	-69.50	121.00	EASTMAN
267.90	-69.90	151.00	EASTMAN
268.00	-69.00	181.00	EASTMAN
269.50	-70.00	211.00	EASTMAN
270.00	-69.90	241.00	EASTMAN
271.30	-70.20	277.00	EASTMAN
272.00	-69.70	307.00	EASTMAN
272.00	-69.70	334.00	EASTMAN
272.50	-70.10	364.00	EASTMAN

BSD088

FROM (m)	TO (m)	LITHOLOGY	FROM (m)	TO (m)	SAMPLE NUMBER	LAB JOB NO	PX NO	As	Co	Cr	Cu	Fe %	Mg %	Ni %	S %	Zn	S:Ni	Fe:N
0.00	3.00	SOIL																
3.00	11.00	LAT																
11.00	29.00	Fe/CLAY																
29.00	40.00	CW/FV?																
40.00	58.00	CW/KOM?																
58.00	66.00	CRB/KOM?																
66.00	81.30	CRB/KOM?																
81.30	85.23	KOM/FLOW TOP SEQ	81.30	82.30	76052	PE019228	1793	155.0	140	2196	65	10.35	5.90	0.14	0.850	132	6.07	73.9
			82.30	83.30	76053	PE019228	1793	186.0	122	1878	91	9.75	5.80	0.15	0.830	128	5.53	65.0
			83.30	84.30	76054	PE019228	1793	256.0	118	1755	61	7.35	6.63	0.14	0.300	125	2.14	52.5
			84.30	85.23	76055	PE019228	1793	167.0	105	1520	69	7.41	6.50	0.11	0.610	303	5.55	67.3
85.23	86.52	KOM/FLOW	85.23	86.52	76056	PE019228	1793	178.0	130	2006	105	7.78	6.37	0.15	1.120	288	7.47	51.8
86.52	87.97	FV	86.52	87.97	76057	PE019228	1793	33.0	8	76	19	3.69	3.74	0.01	1.100	35	110.00	369.
87.97	96.00	KOM/PxSTX?	87.97	89.00	76058	PE019228	1793	77.0	52	841	37	6.23	8.90	0.06	0.490	56	8.17	103.
			89.00	90.00	76059	PE019228	1793	150.0	86	1303	73	6.11	8.14	0.10	0.130	73	1.30	61.1
			90.00	91.00	76060	PE019228	1793	165.0	90	1339	59	5.89	9.53	0.10	0.020	64	0.20	58.9
			91.00	92.00	76061	PE019228	1793	160.0	94	1127	66	5.74	11.00	0.09	0.002	61	0.02	63.7
			92.00	93.00	76062	PE019228	1793	227.0	110	1490	77	6.91	11.20	0.11	0.002	77	0.02	62.8
			93.00	94.00	76063	PE019228	1793	196.0	101	1377	58	6.69	11.40	0.11	0.002	71	0.02	60.8
			94.00	95.00	76064	PE019228	1793	206.0	93	1370	81	6.69	10.80	0.12	0.002	74	0.02	55.7
			95.00	96.00	76065	PE019228	1793	202.0	84	1528	57	6.79	12.20	0.11	0.002	72	0.02	61.7
96.00	98.55	TA/CRB/PxSTX	96.00	97.00	76066	PE019228	1793	158.0	102	1516	69	7.15	13.90	0.12	0.002	75	0.02	59.5
98.55	120.36	TA/CRB																
120.36	122.10	TA/CRB/WEATH/STX																
122.10	131.70	TA/CRB																
131.70	321.60	TA/CRB	313.00	314.00	76042	PE019228	1793	5.0	102	1868	66	6.10	16.10	0.17	0.002	61	0.01	35.8
			314.00	315.00	76043	PE019228	1793	5.0	102	1766	43	6.33	16.10	0.16	0.002	53	0.01	39.5
			315.00	316.00	76044	PE019228	1793	13.0	111	1825	70	6.28	16.00	0.17	0.002	57	0.01	36.9
			316.00	317.00	76045	PE019228	1793	10.0	95	1725	44	5.95	15.90	0.15	0.002	55	0.01	39.6
			317.00	318.00	76046	PE019228	1793	5.0	88	1792	42	5.88	15.00	0.16	0.002	53	0.01	36.7
			318.00	319.00	76047	PE019228	1793	5.0	93	1655	55	6.16	15.00	0.15	0.002	61	0.01	41.0
			319.00	320.00	76048	PE019228	1793	5.0	71	1402	32	6.28	13.30	0.12	0.002	55	0.02	52.3
			320.00	321.60	76049	PE019228	1793	70.0	96	1729	32	7.20	11.20	0.12	0.090	81	0.75	60.0
321.60	335.40	FV	321.60	322.40	76050	PE019228	1793	35.0	41	298	44	3.07	2.64	0.03	0.040	45	1.33	102.
335.40	366.50	CRB/KOM																

SILVER SWAN NICKEL PROJECT
DIAMOND DRILL LOGS

HOLE	NORTH	EAST	AMG NORTH	AMG EAST	RL	AZIMUTH GRID	AZIMUTH MAG.	DIP	LENGTH	TENEMENT
BSD088A	20000	20190	6636212.140	370675.600	1360.52	270	270	-70	438	

WEDGED OF BSD88

AZIMUTH	DIP	DEPTH	TYPE
272.40	-70.02	358.10	COLLAR
269.50	-68.10	358.20	CALC.
269.50	-68.10	384.00	EASTMAN
264.00	-67.60	414.00	EASTMAN
261.60	-66.80	438.00	EASTMAN

BSD088A

FROM (m)	TO (m)	LITHOLOGY	FROM (m)	TO (m)	SAMPLE NUMBER	LAB JOB NO	PX NO	As	Co	Cr	Cu	Fe %	Mg %	Ni %	S %	Zn	S:Ni	Fe:Ni
360.30	366.00	CRB/KOM?																
366.00	367.70	ROCK ROLLER/FAULT																
367.70	410.73	CRB/KOM?	399.00	400.00	76068	PE019482	1794	190.0	101	2043	60	7.23	10.59	0.13	0.002	86	0.02	55.62
			400.00	401.00	76069	PE019482	1794	204.0	97	1631	42	6.66	11.10	0.12	0.002	83	0.02	55.5
			401.00	402.00	76070	PE019482	1794	138.0	81	1474	52	6.24	11.04	0.11	0.002	71	0.02	56.7
			402.00	403.00	76071	PE019482	1794	85.0	96	1587	49	7.10	13.25	0.12	0.002	73	0.02	59.1
			403.00	404.00	76072	PE019482	1794	76.0	76	1316	31	6.17	13.09	0.11	0.002	68	0.02	56.0
			404.00	405.00	76073	PE019482	1794	60.0	80	1594	31	6.74	12.94	0.12	0.002	76	0.02	56.1
			405.00	406.00	76074	PE019482	1794	87.0	87	1355	38	6.05	12.48	0.11	0.002	68	0.02	55.0
			406.00	407.00	76075	PE019482	1794	179.0	81	1389	29	6.13	12.90	0.11	0.080	65	0.73	55.7
			407.00	408.00	76076	PE019482	1794	294.0	77	1322	39	5.68	11.46	0.10	0.002	60	0.02	56.8
			408.00	409.00	76077	PE019482	1794	141.0	162	2450	226	9.40	7.72	0.13	0.002	131	0.02	72.3
			409.00	410.00	76078	PE019482	1794	158.0	142	2025	142	8.87	4.92	0.10	0.002	113	0.02	88.7
			410.00	410.73	76079	PE019482	1794	316.0	168	1917	106	6.65	3.17	0.08	0.080	159	1.00	83.1
410.73	438.00	FV	410.73	412.00	76080	PE019482	1794	36.0	20	49	26	1.18	0.66	0.01	0.002	16	0.20	118.
			412.00	413.00	76081	PE019482	1794	16.0	16	20	35	1.29	0.61	0.01	0.002	16	0.20	129.
			413.00	414.00	76082	PE019482	1794	5.0	11	16	24	1.55	0.66	0.00	0.002	18	-	-

SILVER SWAN NICKEL PROJECT
DIAMOND DRILL LOGS

HOLE ID	LOCAL NORTH	EAST	AMG NORTH	EAST	RL	AZIMUTH GRID	MAG.	DIP	LENGTH	TENEMENT
BSD092	11899.824	10563.766	6637380.724	369980.838	1365.604	270	234	-60	598	M27/200

AZIMUTH	DIP	DEPTH	TYPE	COMMENT
270.00	-60.00	0.00	EASTMAN	
269.00	-60.10	34.00	EASTMAN	
268.00	-60.80	64.00	EASTMAN	
267.50	-60.60	88.00	EASTMAN	
267.50	-60.90	118.00	EASTMAN	
268.00	-60.50	148.00	EASTMAN	
267.00	-60.50	178.00	EASTMAN	
268.20	-61.00	208.00	EASTMAN	
269.00	-61.00	238.00	EASTMAN	
268.90	-61.00	268.00	EASTMAN	
268.80	-61.00	298.00	EASTMAN	
269.00	-61.00	328.00	EASTMAN	
269.50	-60.80	367.00	EASTMAN	
269.20	-61.00	391.00	EASTMAN	
269.20	-61.00	421.00	EASTMAN	
269.50	-61.40	451.00	EASTMAN	
270.50	-61.40	481.00	EASTMAN	
270.50	-61.80	511.00	EASTMAN	
269.00	-62.00	541.00	EASTMAN	
271.00	-61.80	571.00	EASTMAN	
271.0	-61.20	598.00	EASTMAN	

BSD092

FROM (m)	TO (m)	LITHOLOGY	FROM (m)	TO (m)	SAMPLE NUMBER	LAB JOB NO	PX NO	As	Co	Cr	Cu	Fe %	Mg %	Ni %	S %	Zn	S:Ni	Fe:Ni
0.00	7.00	CALC	0.00	2.00	83788	PE023073	2224	17	24	807	44	12.39	0.63	0.02		42		619.5
			2.00	4.00	83789	PE023073	2224	24	52	522	44	9.19	1.64	0.04		39		229.7
			4.00	6.00	83790	PE023073	2224	39	105	585	46	9.95	5.83	0.08		39		124.3
7.00	8.00	LAT	6.00	8.00	83791	PE023073	2224	83	80	1396	71	21.95	1.19	0.19		76		115.5
8.00	27.00	CLAY	8.00	10.00	83792	PE023073	2224	43	66	2144	102	18.57	4.81	0.26		86		71.42
			10.00	12.00	83793	PE023073	2224	30	67	1540	51	9.78	4.09	0.28		80		34.93
			12.00	14.00	83794	PE023073	2224	26	75	1733	22	15.59	7.99	0.28		58		55.68
			14.00	16.00	83795	PE023073	2224	29	77	2242	25	15.29	6.46	0.24		80		63.71
			16.00	18.00	83796	PE023073	2224	47	61	2743	28	18.36	5.41	0.20		80		91.80
			18.00	20.00	83797	PE023073	2224	37	32	1379	54	11.90	1.62	0.08		50		148.7
			20.00	22.00	83798	PE023073	2224	28	74	2509	49	13.07	5.71	0.20		89		65.35
			22.00	24.00	83799	PE023073	2224	18	142	2635	108	10.71	6.87	0.28		129		38.25
			24.00	26.00	83800	PE023073	2224	5	1353	1863	131	4.68	6.96	0.45		188		10.40
27.00	28.00		26.00	28.00	83801	PE023073	2224	11	714	1464	28	6.07	9.06	0.42		210		14.45
28.00	35.00	SAP/TA/CRB	28.00	30.00	83802	PE023073	2224	11	195	1057	11	5.50	3.66	0.30		141		18.33
			30.00	32.00	83803	PE023073	2224	5	139	947	9	5.66	2.98	0.28		101		20.21
			32.00	34.00	83804	PE023073	2224	5	88	1291	15	5.71	4.29	0.31		164		18.42
35.00	37.00	PW/TA/CRB	34.00	36.00	83805	PE023073	2224	5	98	963	6	4.15	14.41	0.34		105		12.21
			36.00	38.00	83806	PE023073	2224	5	82	545	2	2.90	20.21	0.24		38		12.08
37.00	69.00	TA/CRB	38.00	40.00	83807	PE023073	2224	5	96	515	2	2.60	19.81	0.25		40		10.40
			40.00	42.00	83808	PE023073	2224	5	95	465	2	2.77	20.38	0.27		27		10.26
			42.00	44.00	83809	PE023073	2224	5	92	473	2	2.97	20.21	0.26		36		11.42
			44.00	46.00	83810	PE023073	2224	12	98	523	2	2.61	21.35	0.27		41		9.67
			46.00	48.00	83811	PE023073	2224	5	100	457	2	2.42	20.81	0.26		36		9.31
			48.00	50.00	83812	PE023073	2224	5	105	487	2	2.40	21.54	0.26		41		9.23
			50.00	52.00	83813	PE023073	2224	5	112	500	4	2.38	20.53	0.26		56		9.15
			52.00	54.00	83814	PE023073	2224	5	96	455	2	2.00	20.38	0.26		54		7.69
			54.00	56.00	83815	PE023073	2224	5	79	430	6	1.94	20.00	0.26		61		7.46
			56.00	58.00	83816	PE023073	2224	11	91	468	6	2.00	20.71	0.25		73		8.00
			58.00	60.00	83817	PE023073	2224	14	85	476	5	2.01	21.42	0.26		68		7.73
			60.00	62.00	83818	PE023073	2224	12	84	600	2	2.15	19.79	0.25		61		8.60
			62.00	64.00	83819	PE023073	2224	5	83	564	2	2.39	21.18	0.26		103		9.19
			64.00	66.00	83820	PE023073	2224	5	87	568	2	2.28	21.08	0.27		63		8.44
			66.00	68.00	83821	PE023073	2224	5	98	592	2	2.81	19.69	0.24		45		11.7
			68.00	69.00	83822	PE023073	2224	5	90	880	11	4.21	17.09	0.25		83		16.8
69.00	265.20	TA/CRB																
265.20	268.00	QTZ/CRB/KOM																
268.00	331.00	FV/MLITH/CLASTIC/BRECCIA																
331.00	351.90	FV/MLITH/COHERENT/LAVA?																
351.90	352.80	CRB/FV/KOM/SHEAR																
352.80	355.00	CRB/TA																
355.00	356.80	FPO/MSYN																
356.80	358.50	QTZ/CRB/VEINED/WEATH/KOM																
358.50	361.15	FPO/MSYN																

CONTINUE

BSD092 *CONTINUED*

FROM (m)	TO (m)	LITHOLOGY	FROM (m)	TO (m)	SAMPLE NUMBER	LAB JOB NO	PX NO	As	Co	Cr	Cu	Fe %	Mg %	Ni %	S %	Zn	S:Ni	Fe:Ni
361.15	371.40	TA/CRB																
371.40	374.80	FPO/MSYN																
374.80	414.30	TA/CRB																
414.30	415.70	FPO/MSYN																
415.70	519.00	TA/CRB																
519.00	535.00	TA/CRB																
535.00	539.80	CRB/TA/Ooc																
539.80	541.50	CRB/Ooc/HAR/KOM																
541.50	543.20	CRB/KOM																
543.20	545.20	FV/LAVA																
545.20	553.30	KOM/FV?																
553.30	573.90	FV/LAA/CLASTIC																
573.90	574.15	FI																
574.15	598.00	FV/LAVA/CLASTIC																

SILVER SWAN NICKEL PROJECT
DIAMOND DRILL LOGS

HOLE ID	LOCAL NORTH	EAST	AMG NORTH	EAST	RL	AZIMUTH GRID	MAG.	DIP	LENGTH	TENEMENT
BSD112	12852.168	10231.760	6637960.381	369155.848	1375.370	268.22	232.22	-65.07	586.00	M27/200

AZIMUTH	DIP	DEPTH	TYPE	COMMENT
268.22	-65.07	0.00	DEMAG	
268.89	-64.48	10.00	DEMAG	
269.33	-64.72	20.00	DEMAG	
270.37	-65.16	30.00	DEMAG	
269.94	-65.00	40.00	DEMAG	
271.40	-64.91	50.00	DEMAG	
270.96	-65.00	60.00	DEMAG	
268.96	-64.76	80.00	DEMAG	
270.72	-65.06	90.00	DEMAG	
270.30	-64.77	110.00	DEMAG	
270.00	-64.91	120.00	DEMAG	azimuth adjusted
270.00	-65.04	130.00	DEMAG	azimuth adjusted
269.84	-64.86	140.00	DEMAG	
270.22	-64.63	160.00	DEMAG	
270.00	-64.61	170.00	DEMAG	azimuth adjusted
270.00	-64.74	180.00	DEMAG	azimuth adjusted
270.00	-64.49	190.00	DEMAG	azimuth adjusted
270.00	-64.37	200.00	DEMAG	azimuth adjusted
270.00	-64.27	210.00	DEMAG	azimuth adjusted
270.00	-64.09	220.00	DEMAG	azimuth adjusted
270.00	-64.09	230.00	DEMAG	azimuth adjusted
269.70	-64.15	240.00	DEMAG	azimuth adjusted
269.70	-63.84	250.00	DEMAG	azimuth adjusted
269.70	-63.77	260.00	DEMAG	azimuth adjusted
269.70	-63.67	270.00	DEMAG	azimuth adjusted
269.70	-63.55	280.00	DEMAG	azimuth adjusted
269.70	-63.47	290.00	DEMAG	azimuth adjusted
269.70	-63.36	300.00	DEMAG	azimuth adjusted
269.70	-63.26	310.00	DEMAG	azimuth adjusted
269.70	-63.60	320.00	DEMAG	azimuth adjusted
269.70	-63.34	340.00	DEMAG	azimuth adjusted
269.70	-63.18	350.00	DEMAG	azimuth adjusted
269.70	-63.09	360.00	DEMAG	azimuth adjusted
269.70	-63.20	370.00	DEMAG	azimuth adjusted
269.70	-63.38	390.00	DEMAG	azimuth adjusted
269.70	-63.40	400.00	DEMAG	azimuth adjusted

BSD112

AZIMUTH	DIP	DEPTH	TYPE	COMMENT
269.70	-63.50	410.00	DEMAG	azimuth adjusted
269.70	-63.55	420.00	DEMAG	azimuth adjusted
269.70	-63.44	430.00	DEMAG	azimuth adjusted
269.54	-63.32	440.00	DEMAG	
269.36	-63.27	450.00	DEMAG	
269.32	-63.26	460.00	DEMAG	
269.60	-63.14	470.00	DEMAG	
269.97	-63.05	480.00	DEMAG	
269.78	-62.90	490.00	DEMAG	
269.84	-62.78	500.00	DEMAG	
269.73	-62.58	510.00	DEMAG	
270.14	-62.37	520.00	DEMAG	
270.25	-62.13	530.00	DEMAG	
270.42	-61.90	540.00	DEMAG	
270.35	-61.46	560.00	DEMAG	
270.51	-61.24	570.00	DEMAG	
270.45	-60.94	580.00	DEMAG	

BSD112

FROM (m)	TO (m)	LITHOLOGY	FROM (m)	TO (m)	SAMPLE NUMBER	LAB JOB NO	PX NO	As ppm	Co ppm	Cr ppm	Cu ppm	Fe %	Mg %	Ni %	S %	Zn ppm	S : Ni	Fe : Ni
0.00	5.00	LAT																
5.00	12.00	SAP CLAYS/FELSIC																
12.00	32.00	MW PHYRIC FELSIC																
32.00	39.00	SW PHYRIC FELSIC																
39.00	45.00	PHYRIC FELSIC																
45.00	120.00	TA/CRB																
120.00	145.00	TA/CRB																
145.00	159.90	CRB/TA/2-4mm/Ooc																
159.90	204.80	TA/CRB/3-5mm/Ooc																
204.80	222.00	TA/CRB/SP/1-3mm/Ooc																
222.00	294.40	SP/1-4mm/Ooc																
294.40	331.70	TA/CRB/SP																
331.70	368.70	SP/1-3mm/Ooc																
368.70	379.40	CRB/TA/1-3mm/Ooc																
379.40	398.00	SP/1-3mm/Ooc																
398.00	426.00	CRB/TA/1-3mm/Ooc																
426.00	426.40	CHL/DYKE?																
426.40	427.70	TA/KOM																
427.70	442.00	CRB/TA/1-3mm/Ooc																
442.00	469.50	TA/CRB																
			466.00	467.00	101855	WM034366	2385	<10	105	1162	61	5.00	14.59	0.18	0.010	32	0.06	27.78
			467.00	468.00	101856	WM034366	2385	11	104	1533	20	5.08	15.07	0.16	0.008	38	0.05	31.75
			468.00	468.70	101857	WM034366	2385	<10	83	1071	46	5.00	12.03	0.12	0.003	37	0.03	41.67
			468.70	469.50	101858	WM034366	2385	<10	71	1103	38	4.89	9.27	0.08	0.005	53	0.06	61.12
469.50	483.00	FV/CRYSTAL/LITHIC/BRECCIA																
			469.50	470.00	101859	WM034366	2385	<10	9	26	9	1.12	1.32	0.00	0.122	15		
			470.00	471.00	101860	WM034366	2385	<10	7	13	<5	0.85	1.16	0.00		7		
			471.00	472.00	101861	WM034366	2385	<10	5	<10	<5	0.72	1.35	0.00		6		
483.00	488.70	FI																
488.70	489.05	TA/CRB/KOM																
489.05	513.45	FI																
513.45	552.05	FV																
552.05	560.85	FI																
560.85	586.00	FV/CRYSTAL/LITHIC BRECCIA																

BSD112

FROM (m)	TO (m)	SAMPLE NUMBER	LAB JOB NO	PX NO	Al %	Ca ppm	Mn ppm	Ti ppm	Zr ppm
466.00	467.00	101855	WM034366	2385	1.18	16423	869	173	12
467.00	468.00	101856	WM034366	2385	1.00	14787	1069	159	11
468.00	468.70	101857	WM034366	2385	1.84	33032	811	167	17
468.70	469.50	101858	WM034366	2385	4.16	44971	746	1281	37
469.50	470.00	101859	WM034366	2385	6.49	21530	212	3219	125
470.00	471.00	101860	WM034366	2385	7.50	19968	118	3953	147
471.00	472.00	101861	WM034366	2385	7.43	23614	124	4179	143

Appendix 7

Rocktype	Expanded rock name
$M	Massive sulfide
$M + UKM	Massive sulfide + komatiite flow margin material
$M CrS	Massive sulfide with skeletal chromite
$Mbxfp	Massive sulfidebxfp
$Mcr	Massive sulfide with skeletal chromite
$MCrS	Massive sulfide with skeletal chromite
$Mfi	Massive sulfide with felsic inclusions
$Mfi/$Mt	Massive sulfide with felsic inclusions/Massive sulfidet
$Mfp	Massive sulfide with felsic plumes
$Mfp froth	Massive sulfide with felsic plume froth
$Mfp/Contact diff	Massive sulfide with felsic plumes/Contact diffuse
$Mfp/Contact sha	Massive sulfide with felsic plumes/Contact sharp
$MfpCrS	Massive sulfide with felsic plumes and skeletal chromite
$MfpUmi	Massive sulfide with felsic plumesUmi
$Mr	Massive sulfide ribbon textured pn segregations
$Mrfi	Massive sulfide, ribbon textured, felsic inclusions
$Mrfp	Massive sulfide, ribbon textured, felsic plumes
$Mrt	Massive sulfide, ribbon and trellis textured
$Mt	Massive sulfide, trellis textured
$Mtfp	Massive sulfide, trellis textured, felsic plumes
$Mtr	Massive sulfide, trellis to ribbon textured
$Vein/UoOC	Massive sulfide vein in olivine orthocumulate
F	felsic rock, undifferentiated
F$	felsic rock, undifferentiated with sulfide (pyrite)
F(Fbxm?)	Felsic, undifferentiated; possibly Fbxm
F(Fi-alkaline?)	(scarce feldspar micro-toscanite?)
F(lbx?)	(plagioclase dacite-lithic breccia?)
F(pm)	felsic rock, undifferentiated; partial melt?
F+M/Um	Felsic mixed with mafic or ultramafic, undifferentiated
F+UKM	Felsic mixed with UKM, undifferentiated
F+Um	Felsic mixed with Um, undifferentiated
F+Um+vein	Felsic mixed with UKM and a vein
F+Um?	Felsic mixed with Um?, undifferentiated

Rocktype	Expanded rock name
F/I	felsic rock, undifferentiated; Upper Felsic or Footwall Felsic?
F/I$	felsic rock with sulfides (pyrite), undifferentiated; Upper Felsic or Footwall Felsic?
F/Um	Felsic or ultramafic?
FaPP	amphibole plagioclase porphyry
FaPP$+Um	FaPP mixed with Um and sulfides (pyrite)
FaPP?	Possibly FaPP
FaPPchill	Quenched+/- chloritized marins of FaPP
Fault	
fault+UoC	Fault zone with Um fragments
FbPP	biotite plagioclase porphyry
Fbx	plagioclase-quartz dacite-lithic breccia
Fbx$	pyritic plagioclase-quartz dacite-lithic breccia
Fbx$+M?	Fbx$ mixed with M
Fbx$+Um	Fbx$ mixed with Um
Fbx$+UoOC	Fbx$ mixed with UoOC
Fbx+mt	Fbx with magnetite blebs after pyritic clasts?
Fbx+Um	Fbx mixed with Um
Fbx+vein+Um?	Fbx , veined and mixed with Um
Fbx/Fi	plagioclase-quartz dacite-lithic breccia or micro-granodiorite
Fbx/FL	plagioclase-quartz dacite-lithic breccia or dacite lava
Fbx/Ibx	dacite-lithic breccia; Upper Felsics or Footwall Felsic?
Fbx?	plagioclase-quartz dacite-lithic breccia?
Fbxm	megacrystic plagioclase-quartz dacite-lithic breccia
Fbxm$	pyritic megacrystic plagioclase-quartz dacite-lithic breccia
Fbxm+UKM	Fbxm mixed with UKM
Fbxm+UKS	Fbxm mixed with UKS
Fbxm+Um	Fbxm mixed with Um
Fbxm-FLm	Fbxm with fingers of FL
Fbxm?	megacrystic plagioclase-quartz dacite-lithic breccia?
Fbxw	clast-deformed plagioclase-quartz dacite-lithic breccia
Felsic Xenomelt?	Felsic xenomelt or hybrid mixed melt zone
Fhybrid?	Hybrid F and Um?
Fi	felsic intrusive, undifferentiated

Rocktype	Expanded rock name
Fi-alkaline	scarce feldspar micro-toscanite
Fi-alkaline+Um	Fi-alkaline mixed with Um
Fiap	aphyric micro-granodiorite
Fincl	felsic inclusion, undifferentiated
Fincl$	felsic inclusion with sulfides
Fincl?	felsic inclusion?, undifferentiated
FL	plagioclase-quartz dacite
FL-Fbx	FL with lenses of Fbx
FL/Ft	plagioclase-quartz dacite or felsic tuff
FL/IL	plagioclase dacite
FLm	megacrystic plagioclase-quartz dacite
FLm?	megacrystic plagioclase-quartz dacite?
Flst	crystal-lithic lappillistone
Flst$	pyritic crystal-lithic lappillistone
Flst+Fbx	crystal-lithic lappillistone and plagioclase-quartz dacite-lithic breccia
Flst+Fbx$	pyritic crystal-lithic lappillistone and plagioclase-quartz dacite-lithic breccia
Flst+Ft	crystal-lithic lappillistone and plagioclase crystal tuff
Flst+Ft$	pyritic crystal-lithic lappillistone and plagioclase crystal tuff
Flstm+Fbxm	megacrystic crystal-lithic lappillistone and plagioclase-quartz dacite-lithic breccia
Ft	crystal tuff
Ft$	pyritic crystal tuff
Ft$+Ooc	Ft$ mixed with Um
Ft+Fbx	crystal tuff and plagioclase-quartz dacite-lithic breccia
Ft+Fbx$	pyritic crystal tuff and plagioclase-quartz dacite-lithic breccia
Ft+Flst	crystal tuff and crystal-lithic lappillistone
Ft+Flst$	pyritic crystal tuff and crystal-lithic lappillistone
Ft?	crystal tuff?
Ftm+Fbxm	megacrystic crystal tuff and plagioclase-quartz dacite-lithic breccia
Fuchsite	Fuchsitic vein material
FV	felsic volcanic, undifferentiated
FV+$M	Felsic volcanic, undiff, plus massive sulfide
FV+cr	Felsic volcanic (xenomelt?) with disseminated skeletal chromite
FV/HM	Felsic volcanic (xenomelt) or hybrid mixed melt zone

Rocktype	Expanded rock name
Fxenomelt?	Felsic volcanic (xenomelt) or hybrid mixed melt zone
FZ	Fault zone
I	Footwall Felsic, undifferentiated
I+UKM	I mixed with UKM
I+Um	I mixed with Um
I+Um?	I mixed with Um?
I/M	intermediate or mafic rock?
I?	Footwall Felsic?, undifferentiated
Ibx	plagioclase dacite-lithic breccia
Ibx$	pyrite-plagioclase dacite-lithic breccia
Ibx$+Um	Ibx mixed with Um and sulfides (pyrite)
Ibx+UKMh	Ibx mixed with UKMh
Ibx+Um	Ibx mixed with Um
Ibx+Um?	Ibx mixed with Um?
Ibx-Ibxw	plagioclase dacite-lithic breccia and clast-deformed breccia
Ibx-IL	plagioclase dacite-lithic breccia and plagioclase dacite
Ibx-It	plagioclase dacite-lithic breccia and plagioclase crystal tuff
Ibx/Fbx	dacite lithic breccia
Ibx/IL	plagioclase dacite-lithic breccia or plagioclase dacite
Ibx?	plagioclase dacite-lithic breccia?
Ibxhy	splintery and blocky clast aphanitic tracyandesite-lithic breccia
Ibxw	clast-deformed plagioclase dacite-lithic breccia
Ibxw+Um?	clast-deformed plagioclase dacite-lithic breccia +Um?
Ibxw-IL	clast-deformed plagioclase dacite-lithic breccia and plagioclase dacite
Ibxw?	clast-deformed plagioclase dacite-lithic breccia?
Ii	intermediate intrusive, undifferentiated
Ii/Iincl	intermediate intrusive or inclusion?
Ii?	intermediate intrusive, undifferentiated?
Iip	plagioclase microdiorite
Iip+RZ	Quenched+/- chloritized marins of Iip
IL	plagioclase dacite
IL$	pyrite-plagioclase dacite
IL+Um?	plagioclase dacite + Um

Rocktype	Expanded rock name
IL-Ibx	IL with lenses of Ibx
IL/FL?	plagioclase or plagioclase-quartz dacite
IL/Um	plagioclase dacite or Um?
IL?	plagioclase dacite?
IL?+$	pyrite-plagioclase dacite?
It	plagioclase crystal tuff
It+Ilst	plagioclase crystal tuff and crystal-lithic lapillistone
It+UKMh	It mixed with UKMh
It+Um	It mixed with Um
It?	plagioclase crystal tuff?
MBM	High Mg Basalt, no texture
MBSbx	Basaltic flow top bx
MD	Dolerite/mafic intrusive
Mi	Mafic intrusive
Mi/Lamp	Mafic intrusive, ?lamprophyric
MKSp	High Mg Basalt, px spinifex texture
MKSp2	High Mg Basalt, px spinifex texture (A2)
MZ	Mixed zone
UKM	Komatiite flow margin, qtz-chlor-carb, no texture
UKM + Crs	Komatiite flow margin, qtz-chlor-carb, no texture, with skeletal chromite
UKM bx	Komatiite flow margin, qtz-chlor-carb, no texture, brecciated
UKM contam	Komatiite flow margin, qtz-chlor-carb, no texture, contaminated
UKM vesic	Komatiite flow margin, qtz-chlor-carb, vescicular
UKM/HM	Komatiite flow margin, hybridised with feslic fragments or xenomelt
UKM/HM/MZ	Komatiite flow margin, hybridised with feslic fragments or xenomelt
UKM/UKS	Komatiite flow margin, possible faint spinifex texture
UKM/UKS/UoOC	Komatiite flow margin, possible faint spinifex texture
UKM/UKS?	Komatiite flow margin, possible faint spinifex texture
UKM/UKSo	Komatiite flow margin, possible faint olivine spinifex texture
UKM/UKSo?	Komatiite flow margin, possible faint olivine spinifex texture
UKM/UKSp	Komatiite flow margin, possible faint pyroxene spinifex texture
UKM/UoC	Komatiite flow margin or undifferentiated cumulate, no texture
UKM/UoC undiff	Komatiite flow margin or undifferentiated cumulate, no texture

Rocktype	Expanded rock name
UKM/UoOC	Komatiite flow margin or undifferentiated orthocumulate, no texture
UKM/UoOCf	Komatiite flow margin or undifferentiated fine grained orthocumulate, no texture
UKM[$]	Komatiite flow margin with disseminated sulfide
UKMbx	Komatiite flow margin, brecciated
UKMh	Komatiite flow margin, hybridised with felsic fragments or xenomelt
UKOS	Spinifex textured komatiite, olivine spinifex
UKoS1	Spinifex textured komatiite, olivine spinifex A1
Ukps2	Spinifex textured komatiite, pyroxene spinifex A2
UKS	Spinifex textured komatiite, undifferentiated
UKS contaminate	Spinifex textured komatiite, contaminated
UKS vesic	Spinifex textured komatiite, vescicular
UKS1/2	Spinifex textured komatiite, A1 or 2, olivine or pyroxene
UKS2	Spinifex textured komatiite, A2, olivine or pyroxene
UKSo	Spinifex textured komatiite, olivine spinifex
UKSo vesic	Spinifex textured komatiite, olivine spinifex, vescicular
UKSo/3	Spinifex textured komatiite, olivine spinifex, A3
UKSo[$]	Spinifex textured komatiite, olivine spinifex with dissem $
UKSo1	Spinifex textured komatiite, A1, olivine
UKSo1 vesic	Spinifex textured komatiite, A1, olivine, vescicular
UkSo1/2	Spinifex textured komatiite, A1/A2, olivine
UKSo1/2/3	Spinifex textured komatiite, A1/A2/A3, olivine
UKSo2	Spinifex textured komatiite, A2, olivine
UKSo3	Spinifex textured komatiite, A3, olivine
UKSp	Spinifex textured komatiite, pyroxene spinifex A2
UKSp vesic	Spinifex textured komatiite, pyroxene spinifex, vescicular
UKSp1	Spinifex textured komatiite, A1, pyroxene spinifex
UKSp2	Spinifex textured komatiite, A2, pyroxene spinifex
UKSV	Spinifex trextured veins, irregular, crosscutting cumulates
Um	Undifferentiated ultramafic rock, highly altered
UoAC	Olivine adcumulate
UoACbm	Olivine adcumulate, bimodal, 2-6 mm olivines
UoACf	Olivine adcumulate, <2mm olivines
UoC	Olivine cumulate, undifferentiated

Rocktype	Expanded rock name
UoC vesic	Olivine cumulate, undifferentiated, vescicular
UoC[$]	Olivine cumulate, undifferentiated, dissem $
UoCm	Olivine cumulate, undifferentiated, 2-6mm olivines
UoMC	Olivine mesocumulate, undifferentiated
UoMCbc	Olivine mesocumulate, bimodal, >6mm olivines
UoMCbc[$]	Olivine mesocumulate, bimodal, >6mm olivines, dissem $
uOMCbf	Olivine mesocumulate, bimodal, <2 mm olivines
UoMCbhm	Olivine mesocumulate, bimodal, hopper grains, 2-6 mm olivines
UoMCbm	Olivine mesocumulate, bimodal, 2-6mm olivine
UoMCbm[$]	Olivine mesocumulate, bimodal, 2-6mm olivine, dissem $
UoMCc	Olivine mesocumulate, undifferentiated, >6mm olivine
UoMCc[$]	Olivine mesocumulate, undifferentiated, >6mm olivine, d$
UoMCchc[$]	Olivine mesocumulate, coarse hopper, >6mm olivine, d$
UoMCf	Olivine mesocumulate, undifferentiated, <2mm olivine
UoMChc	Olivine mesocumulate, hopper olivines, >6mm olivine
UoMChm	Olivine mesocumulate, hopper olivines, 2-6mm olivine
UoMCm	Olivine mesocumulate, undifferentiated, 2-6mm olivine
UoMCm[$]	Olivine mesocumulate, undifferentiated, 2-6mm olivine, disseminated sulfide
UoMCmfi	Olivine mesocumulate, undifferentiated, fine to 6 mm olivines
UoMCs	Olivine mesocumulate, sago textured
UoMCs[$]	Olivine mesocumulate, sago textured, disseminated sulfide
UoMCsc	Olivine mesocumulate, sago textured, >6mm olivine
UoMCsf	Olivine mesocumulate, sago textured, <2mm olivine
UoMCsm	Olivine mesocumulate, sago textured, 2-6mm olivine
UoMCsm[$]	Olivine mesocumulate, sago textured, 2-6mm olivine, disseminated sulfide
UoMCwf[$]	Olivine mesocumulate, wormy textured, <2mm olivine, disseminated sulfide
UoOC	Olivine orthocumulate, undifferentiated
UoOC [$]	Olivine orthocumulate, undifferentiated, disseminated sulfide
UoOC vesic	Olivine orthocumulate, undifferentiated, vescicular
UoOC(Harr)	Olivine orthocumulate, harrisitic
UoOC(harr) vesic	Olivine orthocumulate, harrisitic, vesicular, >6 mm olivine
UoOC(Harr)c	Olivine orthocumulate, harrisitic, >6mm olivine
UoOC(Harr)f	Olivine orthocumulate, harrisitic, <2mm olivine

Rocktype	Expanded rock name
UoOC[$]	Olivine orthocumulate, undifferentiated, disseminated sulfide
UoOCb	Olivine orthocumulate, bimodal
UoOCb[$]	Olivine orthocumulate, bimodal, disseminated sulfide
UoOCbc	Olivine orthocumulate, bimodal, >6mm olivine,
UoOCbc?	Olivine orthocumulate, bimodal, >6mm olivine
UoOCbc[$]	Olivine orthocumulate, bimodal, >6mm olivine, disseminated sulfide
UoOCbf	Olivine orthocumulate, bimodal, <2mm olivine,
UoOCbf[$]	Olivine orthocumulate, bimodal, <2mm olivine, disseminated sulfide
UoOCbhc	Olivine orthocumulate, bimodal, hopper olivine, >6mm olivine,
UoOCbhc[$]	Olivine orthocumulate, bimodal, hopper olivine, >6mm olivine, disseminated sulfide
UoOCbhm	Olivine orthocumulate, bimodal, hopper olivine, 2-6mm olivine,
UoOCbhqm	Olivine orthocumulate, bimodal, hopper olivine, quench olivine, 2-6mm olivine,
UoOCbhqm/f	Olivine orthocumulate, bimodal, hopper olivine, quench olivine, <2-6mm olivine
UoOCbhvc[$]	Olivine orthocumulate, bimodal, hopper >6mm olivine, vescicular, disseminated sulfid
UoOCbm	Olivine orthocumulate, bimodal, 2-6mm olivine,
UoOCbm[$]	Olivine orthocumulate, bimodal, 2-6mm olivine, disseminated sulfide
UoOCbm[$] [$c]	Olivine orthocumulate, bimodal, 2-6mm olivine, disseminated sulfide clasts
UoOCbm[$c]	Olivine orthocumulate, bimodal, 2-6mm olivine, dissem sulfide clasts
UoOCbm[$i]	Olivine orthocumulate, bimodal, 2-6mm olivine, dissem sulfide inclusions
UoOCbm[$p]	Olivine orthocumulate, bimodal, 2-6mm olivine, dissem sulfide patches
UoOCbmf	Olivine orthocumulate, bimodal, 2-6mm olivine, <2mm olivine,
UoOCbp	Olivine orthocumulate, bimodal, platey olivine,
uoOCbq f/c	Olivine orthocumulate, bimodal, quench olivine, f/c
UoOCbq[$]	Olivine orthocumulate, bimodal, quench olivine, disseminated sulfide
UoOCbqf	Olivine orthocumulate, bimodal, quench olivine, <2mm olivine,
UoOCbqf/m	Olivine orthocumulate, bimodal, quench olivine, <2mm olivine, /m
UoOCbqm/c	Olivine orthocumulate, bimodal, quench olivine, 2->6mm olivine
UoOCbvm	Olivine orthocumulate, bimodal, vm
UoOCbvm[$]	Olivine orthocumulate, bimodal, vmdisseminated sulfide
UoOCc	Olivine orthocumulate, >6mm olivine,
UoOCc/UoMCc	Olivine orthocumulate, >6mm olivine, /UoMCc
UoOCc[$]	Olivine orthocumulate, >6mm olivine, disseminated sulfide
UoOCcs vesic	Olivine orthocumulate, >6mm olivine, sago, vesic

Rocktype	Expanded rock name
UoOCf	Olivine orthocumulate, <2mm olivine,
UoOChc	Olivine orthocumulate, hopper olivine >6mm olivine,
UoOChc vesic	Olivine orthocumulate, hopper olivine >6mm olivine, vescicular
UoOChc[$]	Olivine orthocumulate, hopper olivine >6mm olivine, disseminated sulfide
UoOChc[$] [$0]	Olivine orthocumulate, hopper olivine >6mm olivine, disseminated sulfide globules
UoOChf	Olivine orthocumulate, hopper olivine <2mm olivine,
UoOChm	Olivine orthocumulate, hopper olivine. 2-6mm olivine,
UoOChqc	Olivine orthocumulate, hopper olivine quench olivine, c
UoOChvc [$0]	Olivine orthocumulate, hopper >6mm olivine, vescicular, dissem sulfide
UoOCm	Olivine orthocumulate, 2-6mm olivine,
UoOCm[$]	Olivine orthocumulate, 2-6mm olivine, disseminated sulfide
UoOCms vesic	Olivine orthocumulate, 2-6mm olivine, s vesic
UoOCpc	Olivine orthocumulate, platey olivine, >6mm olivine,
UoOCpf	Olivine orthocumulate, platey olivine, <2mm olivine,
UoOCpm	Olivine orthocumulate, platey olivine, 2-6mm olivine,
UoOCpvm	Olivine orthocumulate, platey olivine, vm
UoOCs	Olivine orthocumulate, sago,
UoOCs vesic	Olivine orthocumulate, sago, vescicular
UoOCs[$]	Olivine orthocumulate, sago, disseminated sulfide
UoOCsc	Olivine orthocumulate, sago, >6mm olivine,
UoOCsc[$]	Olivine orthocumulate, sago, >6mm olivine, disseminated sulfide
UoOCsf	Olivine orthocumulate, sago, <2mm olivine,
UoOCsf[$]	Olivine orthocumulate, sago, <2mm olivine, disseminated sulfide
UoOCsm	Olivine orthocumulate, sago, 2-6mm olivine,
UoOCsm/f	Olivine orthocumulate, sago, 2-6mm olivine, /f
UoOCsm[$]	Olivine orthocumulate, sago, 2-6mm olivine, disseminated sulfide
UoOCsvf	Olivine orthocumulate, sago, vescicular, <2 mm olivine
UoOCsvf/m	Olivine orthocumulate, sago, vescicular, <2-6 mm olivine
UoOCsvm	Olivine orthocumulate, sago, vescicular, 2-6 mm olivine
UoOCw/bm	Olivine orthocumulate, wormy to bladed, 2-6mm olivine
UoOCwc	Olivine orthocumulate, wormy, >6mm olivine,
uoOCwf	Olivine orthocumulate, wormy, <2mm olivine,
UoOCwf/m	Olivine orthocumulate, wormy, <2-6 mm olivine

Rocktype	Expanded rock name
UoOCwf[$]	Olivine orthocumulate, wormy, <2mm olivine, disseminated sulfide
uOOCwm	Olivine orthocumulate, wormy, 2-6mm olivine,
uoOCwm[$]	Olivine orthocumulate, wormy, 2-6mm olivine, disseminated sulfide
UoOCwmv[$]	Olivine orthocumulate, wormy, 2-6mm olivine, vdisseminated sulfide
UopOC	Olivine pyroxene orthocumulate
UpOC	Pyroxene orthocumulate
UpoOC	Pyroxene olivine orthocumulate

From	*To*	*Rocktype*	*Description*	*Strat pos*	*Expanded rock name*

Hole: ***BSD019***

72	107	Fbxm	coarse-grained megacryst volcaniclastic breccia, fines towards base, matrix is extremely crystal rich, swaths of crystal-rich (really rich >60%) and crystal-poor rock, 5-30 cm alternating intervals	Upper Felsics	megacrystic plagioclase-quartz dacite-lithic breccia
107	109	Flst	same as above but clast outlines partly obscured and difficult to spot, w/, quartz veins up to 2 cm thick veining more abundant in lower (down-hole) meter of unit	Upper Felsics	crystal-lithic lappillistone
109	114.7	Ft+Fbx	megacrystic unit, from 109m, features crystal tuff with horizons ofmegacrystic breccia clasts in crystal tuff matrix.	Upper Felsics	crystal tuff and plagioclase-quartz dacite-lithic breccia
114.7	115.4	MZ/F-UKSp1	Mixed zone, felsic and fine grained px spinifex groundmass, hybrid melt flow top		
115.4	115.7	UKSp2	Gradational contact into px spinifex with very coarse grained sprays acicular crystals, f gr laths plag/quartz, chlorite matrix, now chlorite-quartz-plagioclase-carbonate rock. Samples 115.4-115.7 (TS,XRF)		Spinifex textured komatiite, A2, pyroxene spinifex
115.7	116.5	UopOC	amoeboid olivine-pyroxene ?b zone cumulate (possible quench zone), rare skeletal chromite medium grained chlorite-quartz matrix. Sample 116.45 (TS,XRF)	Lower Ultramafic	Olivine pyroxene orthocumulate
116.45	117.2	UKSp2	random spinifex (pyroxene) A2 zone now chlorite quartz-plagioclase-carbonate-talc. Sample 116.45 (TS,XRF), 117.42 (TS)	Lower Ultramafic	Spinifex textured komatiite, A2, pyroxene spinifex
117.2	118.5	UopOC	carbonate-chlorite-quartz rock, medium to coarse grained polyhedral olivines, coarse grained carbonate porphyroblasts - possible pyroxene pseudomorphs, rare skeletal chromite. Samples 117.45 (TS)	Lower Ultramafic	Olivine pyroxene orthocumulate
118.5	179	UoOCsf	talc carbonate after oOC, possible pathway fill under pyx rich crusts, close packed sago oOC, lobate chromite, spicules of hematite. Sample 122m (TS,XRF)	Lower Ultramafic	Olivine orthocumulate, sago, <2mm olivine,
179	184.2	UkSo1/2	chlorite-talc carbonate rock after A2 spinifex-olivine - also flow top (antigorite chlorite quartz) - coarse chevron olivine, skeletal olivine. Sample 179.4 (1)(TS), 179.4 (2)(TS), 181.4 (TS)	Lower Ultramafic	Spinifex textured komatiite, A1/A2, olivine
184.2	184.2	Contact sharp, F	contact sharp UM/F	Lower Ultramafic	
184.21	186.1	Ii/Iincl	coherent coarsely crystalline felsic rock, a fresh plagioclase -dominated hypabyssal rock	Upper Felsics	intermediate intrusive or inclusion?
186.1	186.1	Contact	contact: sharp	Upper Felsics	
186.1	186.3	Ii/Iincl	same as above but heavily chloritized?	Upper Felsics	intermediate intrusive or inclusion?
186.25	197	UoOCbm	talc-chlorite carbonate after schistose fabric, bimodal oOC, hematite (quartz cores) plates. Sample 191.0 (TS)	Lower Ultramafic	Olivine orthocumulate, bimodal, 2-6mm olivine,
197	197.3	UoOCsm	steel grey talc carbonate, blotchy, >1cm carbonate porphyroblasts, variable texture and grain size after sago oOC	Lower Ultramafic	Olivine orthocumulate, sago, 2-6mm olivine,
197.3	226.2	UoOCbm	talc-carbonate-chlorite quartz after bimodal oOC, close packed, medium to coarse grained elongate tabular and polyhedral olivines, spicules of hematite lobate chromite. Samples 197.3 (TS), 213.8 (TS,XRF), 222.6 (TS,XRF)	Lower Ultramafic	Olivine orthocumulate, bimodal, 2-6mm olivine,
226.2	226.7	UKSo1/2?	very fine grained cuspate, bladed chlorite quartz with quartz-carbonate overprint. Flow top of olivine STX flow or alteration zone (high Zr, low Ni). Sample 226.2 (TS,XRF)	Lower Ultramafic	
226.65	257.1	UoOCbm/ UoMCbm	carbonate-talc-chlorite rock after medium grained bimodal oOC - loosely-tightly-packed polyhedral and rare tabular crystals, rare lobate chromite. Sample 246.8 (TS,XRF), 252.8 (TS)	Lower Ultramafic	
257.1	257.1	Contact sharp	sharp contact felsic intrusive/ultramafic	Lower Ultramafic	
257.11	267.8	Fi-alkaline	pale Green HW intrusive, phenos </= 3 mm, unit aphyric to ~7% phenos (phenos more prominent after 262.5 m)	Upper Felsics	scarce feldspar micro-toscanite

Hole: BSD019					
From	**To**	**Rocktype**	**Description**	**Strat pos**	**Expanded rock name**
267.75	267.8	Contact sharp	sharp contact felsic/ultramafic	Lower Ultramafic	
267.8	300.3	UoMC	talc-carbonate-chlorite rock after UoMC, scattered lobate chromite. Sample 280.7(TS,XRF)	Lower Ultramafic	Olivine mesocumulate, undifferentiated
300.3	300.4	RZ	contact:1.5 to 6 cm zone of stongly chloritized material discordant w/ down-hole contact*	Upper Felsics	
300.35	301.8	Fi-alkaline	pale green fine grained plagioclase phyric (max ~3%) felsic intrusive	Upper Felsics	scarce feldspar micro-toscanite
301.75	301.8	RZ	contact:1.5 to 6 cm zone of stongly chloritized material discordant w/ up-hole contact*	Upper Felsics	
301.8	362.4	UoMC/UoACm	talc-carbonate after layered oMC/oAC, some zones with talc-filled vesicles (eg 333.4). Sample 317.2 (TS,XRF), 338.3 (TS,CA), 352.6 (TS,XRF)	Lower Ultramafic	
362.44	363	UoMCmf	talc carbonate bleached and spotty after oMC medium grained containing rip-up clasts which contain sulfide, ultramafic is barren of sulfide. Sample 362.44 (TS)	Lower Ultramafic	
363	365.5	UoMC	talc carbonate rock, no texture possibly after oMC	Lower Ultramafic	Olivine mesocumulate, undifferentiated
365.5	365.6	RZ/Contact sharp	contact: chloritic alteration zone, discordant w/ down-hole contact	Upper Felsics	
365.6	370.1	FaPP	Salmon Andesite, chl-green to salmon-pink plagioclase phyric coherent unit w/ relict mafic phenos	Upper Felsics	amphibole plagioclase porphyry
370.1	370.9	RZ/Contact sharp	contact: chloritic alteration zone, contains pyrite, discordant w/ up-hole contact, sulfide veins in contact w/ Um	Upper Felsics	
370.9	374.6	UoOCbhc	talc carbonate after olivine cumulate, dark grey/black clots after chromite. Some evidence in carbonate for amoeboid, harrisitic olivines, best described as bimodal harrisitic oOC. Sample 373.6 (TS)	Lower Ultramafic	Olivine orthocumulate, bimodal, hopper olivine, >6mm olivine,
374.6	376.3	lbx	coarse-grained Fw-volcaniclastic breccia, upper 20 cm is strongly chloritized, this interval strongly veined (quartz/carbonate) and leached	Silver Swan footwall	plagioclase dacite-lithic breccia
376.3	382.4	lbx	very coarse-grained monomictic volcaniclastic breccia, heavily altered zones	Silver Swan footwall	plagioclase dacite-lithic breccia
382.35	400.1	IL-lbx	apparent coherent and/or auto-brecciated zones w/ very coarse-grained plagioclase phyric clasts (clast supported volcaniclastic breccia, tightly packed)	Silver Swan footwall	IL with lenses of lbx
400.05	400.1	Contact sharp	sharp contact felsic/ultramafic	Silver Swan footwall	
400.05	400.5	UKSo1/lbx	chloritised flow top breccia in contact with felsic fragmental. Felsic contains matrix of very fine grained chlorite-quartz and altered plagioclase; phenocrysts-plagioclase, ?cuspate crystals, lithic fragments, possible contamination. Sample 400.05-400.5 (TS,XRF)	Silver Swan footwall	
400.5	400.6	UKSo2	carbonate, chlorite, quartz rock after A2 spinifex, skeletal dendritic crystals. Samples 400-5-400.6 (TS,XRF)	Silver Swan footwall	Spinifex textured komatiite, A2, olivine
400.6	414.8	UoOCbhqm/f	talc-carbonate rock after bladed oOC, preponderance of bladed olivines aligned over polyhedral hopper, fine grained acicular matrix, medium grained igneous textures. Rock becomes fine grained (chilled) towards contact. Samples 401.4(TS), 410.1(TS), 412.6(TS,XRF), 413.7(TS,XRF). 114.55m(TM)	Silver Swan footwall	Olivine orthocumulate, bimodal, hopper olivine, quench olivine, <2-6mm olivine
414.75	426.5	lbx	very coarse-grained FW volcaniclastic breccia, heterolithologic look, with intercalated matrix and clast supported zones, pumice?	Footwall Felsics	plagioclase dacite-lithic breccia
426.5	460.3	lbxw	same as above except clast orientation is distinct, becoming more prominent down-core, in lowest 15-20 cm clast fabric is very well developed and flattening of clasts is moderate to strong	Footwall Felsics	clast-deformed plagioclase dacite-lithic breccia
Hole: BSD020					
0	93	precollar	precollar		

Hole: BSD025

From	To	Rocktype	Description	Strat pos	Expanded rock name
474.25	475.5	UKSo1	thin flows, FT and A2 spinifex, quartz, chlorite, carbonate. Samples 474.30(TS), 475.50(TS,XRF)	Silver Swan footwall	Spinifex textured komatiite, A1, olivine
475.5	482	uoOCwf	wormy fine grained, oOC, talc carbonate quartz, marcasite, subhedral, fine grained chromite. Samples 477.80(TS,XRF), 481.60	Silver Swan footwall	Olivine orthocumulate, wormy, <2mm olivine,
482	484	UoOC	talc carbonate rock, no igneous texture - 482.40 po,pym millerite vein 10cm, fine grained sulfide	Silver Swan footwall	Olivine orthocumulate, undifferentiated
484	485.9	uOOCwm	wormy oOC, medium grained bleached but ghosting of igneous texture, 484.90 pyrite vein, dissem sulfide. Sample 485.90	Silver Swan footwall	Olivine orthocumulate, wormy, 2-6mm olivine,
485.9	486.2	HM mixed	variably altered ultramafic or mixed rock zone. very fine grained. subhedral chromite, ?hybrid melt. Sample 486.1m	Silver Swan footwall	
486.2	486.2	$MCrS	skeletal chromite contact with massive sulfide	Silver Swan ore sho	Massive sulfide with skeletal chromite
486.22	488.2	$Mt	massive sulfide, trellis-textured, foliated central portion, inclusion free. Sample 488.00	Silver Swan ore sho	Massive sulfide, trellis textured
488.15	488.2	RZ	contact: sharp/altered	Upper Felsics	
488.15	492.6	FaPP	Salmon andesite, khaki-grey coherent plagioclase phyric, crystal-rich unit, rare $ veins, some thick quartz veins up to 10 cm	Upper Felsics	amphibole plagioclase porphyry
492.6	492.6	Contact sharp	chlorite-rich magnetite contact with massive sulfide. Sample 492.60 at contact		
492.6	498	$Mt	massive sulfide, trellis textured. Sample 492.60	Silver Swan ore sho	Massive sulfide, trellis textured
498	498.3	$Mfi	felsic plume	Silver Swan ore sho	Massive sulfide with felsic inclusions
498.3	506.4	$Mt	massive sulfide, trellis-textured	Silver Swan ore sho	Massive sulfide, trellis textured
506.4	506.9	$Mfi	felsic plume-rich massive sulfide	Silver Swan ore sho	Massive sulfide with felsic inclusions
506.9	507	Contact diffuse	basal contact with footwall felsics		
506.95	509.4	lbx	light to med grey coarse to very coarse grained FW volcaniclastic breccia, heavily altered unit, xl-rich matrix apparent in lower (down-hole) 50 cm; arsenic stringer zone in felsic volcanic 506.95-507.9m	Footwall Felsics	plagioclase dacite-lithic breccia
509.4	538	lbxw	coarse to very coarse grained FW volcaniclastic breccia, some rare darker clasts down hole (not identified) but generally monomict, rare intervals of aligned clasts otherwise random	Footwall Felsics	clast-deformed plagioclase dacite-lithic breccia

Hole: BSD026

From	To	Rocktype	Description	Strat pos	Expanded rock name
98	134.8	Fbxm	coarse grained, megacrystic volcaniclastic breccia, chlorite alteration increases as approach lower contact	Upper Felsics	megacrystic plagioclase-quartz dacite-lithic breccia
134.8	136	UKS	a1 to coarse random a2 over 60cm	Lower Ultramafic	Spinifex textured komatiite, undifferentiated
136	155	UoC	med-grained light grey talc carb, <2mm carbonate p'blasts, trace dissem chromite, no texture, variably oxidised to 150	Lower Ultramafic	Olivine cumulate, undifferentiated
155	223	UoOCbc	tc2 massive grey talc carb, 1-2 mm carbonate p'blasts, trace subhed-lobate chromite, blotchy texture after porph OOC	Lower Ultramafic	Olivine orthocumulate, bimodal, >6mm olivine,
223	223.3	RZ		Lower Ultramafic	
223.3	225.7	MD?	mafic , no spinifex, faint bladed fine px, possible intrusive dolerite, v sharp contacts	Lower Ultramafic	
225.7	248	UoC	med-grained light grey talc carb, <2mm carbonate p'blasts, trace dissem chromite, no texture	Lower Ultramafic	Olivine cumulate, undifferentiated

Hole: BSD026

From	To	Rocktype	Description	Strat pos	Expanded rock name
248	260	UoOCsm	sago 1-4mm weakly aligned olivines s, tr dissem lobate chromite	Lower Ultramafic	Olivine orthocumulate, sago, 2-6mm olivine,
260	294.2	UoOC[$]	sparse dissem chromite, few % dissem $	Lower Ultramafic	Olivine orthocumulate, undifferentiated, disseminated sulfide
294.2	297.6	$M	small chloritic felsic plumes, no chromite at contact	Silver Swan ore sho	Massive sulfide
297.6	303.7	$Mfi	abundant plumes, 15cm OOC xenolith	Silver Swan ore sho	Massive sulfide with felsic inclusions
303.7	304.3	UoOC		Silver Swan ore sho	Olivine orthocumulate, undifferentiated
304.3	315.7	$Mfi	abundant plumes	Silver Swan ore sho	Massive sulfide with felsic inclusions
315.7	324.5	lbx	coarse grained, clast supported, FW volcaniclastic breccia w/ oxidized veins in upper 50 cm (in contact w/ore), packets of coarse grained/medium grained and vcg/coarse grained "beds", sheared and altered	Footwall Felsics	plagioclase dacite-lithic breccia
324.5	327.8	IL	coherent zone or very large clasts (> 1 m)	Footwall Felsics	plagioclase dacite
327.8	329	lbx	medium to coarse grained FW volcaniclastic breccia, plagioclase phyric, SR to subangular cl	Footwall Felsics	plagioclase dacite-lithic breccia
329	342	lbxw-IL	coarse grained (possibly welded) FW volcaniclastic breccia interbedded w/very coarse grained zones that may be coherent lava (0.9-1.7 m-thick)	Footwall Felsics	clast-deformed plagioclase dacite-lithic breccia and plagioclase dacite

Hole: BSD027

From	To	Rocktype	Description	Strat pos	Expanded rock name
60	63	UoOC	fine grained, grey, talc-carbonate	Upper Ultramafics	Olivine orthocumulate, undifferentiated
63	81	UKSo1	ghosting, random texture, suggestion of flow top	Upper Ultramafics	Spinifex textured komatiite, A1, olivine
81	139.3	UoOCbm	fine grained, grey talc-carbonate, subhedral chromite, variably ramifying carbonate veinlets, patches of green talc, elongate tabular and polyhedral olivines, rock medium grained bimodal oOC, closely packed hematite in aligned plates, dusty sulfide. Samples at 81.9(TS,XRF), 111.6(TS,XRF), 123.0(TS,XRF), 124.8(TS,XRF), 139.7(TS,XRF)	Upper Ultramafics	Olivine orthocumulate, bimodal, 2-6mm olivine,
139.3	144.8	UoOCbm	rock contains white crystals which give a porphyritic book, random hematite plates give rock a bladed texture	Upper Ultramafics	Olivine orthocumulate, bimodal, 2-6mm olivine,
144.8	184	UoOCbm	Hematite drops off in amount, rock now characterised by bladed talc, rock is bladed hematite/talc-carbonate, medium to coarse grained, anhedral spinel 181-183 weathered, 183-183.2 fault zone. Samples 154.15(TS,XRF), 171.7(TS,XRF)	Upper Ultramafics	Olivine orthocumulate, bimodal, 2-6mm olivine,
184	186.3	UoOCbm	oxidised and mottled bladed oOC finer grained	Upper Ultramafics	Olivine orthocumulate, bimodal, 2-6mm olivine,
186.25	187.2	HM mixed	chloritized mixed zone predominantly felsic, with fragments of oOC, subhedral white crystal in oOC, possible plagioclase remnants, chloritized felsic. Sample 186.25 (TS, XRF)	Upper Ultramafics	
187.2	247.6	Fbxm	coarse to very coarse-grained megacrystic volcanic breccia, clast size tends to increase down-core, distinct clast types (cl1 and cl2)	Upper Felsics	megacrystic plagioclase-quartz dacite-lithic breccia
247.6	249	UoC	contact zone, altered ultramafic, textureless talc-carbonate rock with felsic porphyry	Upper Ultramafics	Olivine cumulate, undifferentiated
249	350	UoC	fine grained talc-carbonate (±quartz), chromite subhedra, several quartz-carbonate layers devoid of chromite, no remnant igneous texture or evidence of several flow units	Upper Ultramafics	Olivine cumulate, undifferentiated
350	362	UoMCc	mottled talc carbonate rock, subhedralchromite after oMC, coarse grained. Sample 358.6	Upper Ultramafics	Olivine mesocumulate, undifferentiated, >6mm olivine

Hole: BSD043A

From	To	Rocktype	Description	Strat pos	Expanded rock name
335	342	UoOCsf	talc-carbonate±quartz, fine grained closely packed sago oOC (some patches of higher porosity). Scattered fine grained chromite subhedra	Lower Ultramafic	Olivine orthocumulate, sago, <2mm olivine,
342	343	UoOCbc	dark grey-black talc-carbonate after bimodal oOC, medium to coarse grained, variable porosity. Sample at 342.6m, 343.0m	Lower Ultramafic	Olivine orthocumulate, bimodal, >6mm olivine,
343	344.7	HM/UKM/UoOC	dark grey/black fine grained mixed rock or hybrid zone - ?fine grained chill mixed with occasional clumps of oOC and possible felsic volcanic. Samples bimodal oOC 343.3m, mixed rock 344.3m	Lower Ultramafic	
344.7	344.9	HM	thin partial melt zone. Samples at contact 344.7m, 345.0m	Lower Ultramafic	
344.9	347.9	lbx	coarse grained, matrix supported, lbx with c/m = 0.2-0.4, matrix fine to medium grained (fine-grained dom).	Footwall Felsics	plagioclase dacite-lithic breccia
347.9	348.5	Um	Um finger/contam. Upper boundary has 10-cm thick quartz vein, lower boundary seems to follow clast outlines. Avocado green.	Footwall Felsics	Undifferentiated ultramafic rock, highly altered
348.5	352.5	lbx	lbx, evidence of moderately strong shearing/def of clasts.	Footwall Felsics	plagioclase dacite-lithic breccia
352.5	353.2	UoC/FV	ultramafic veining and including felsic volcanic	Lower Ultramafic	
353.2	364	lbx	EOH. coarse grained lbx still matrix supported but marginally so as c/m ~ 0.4-0.6. Matrix is medium-grained. Clastic texture well preserved.	Footwall Felsics	plagioclase dacite-lithic breccia

Hole: BSD044

From	To	Rocktype	Description	Strat pos	Expanded rock name
108	110.4	Fbxm	Dom coarse grained megacrystic breccia, in and out of clast supported and matrix supported (dom matrix supported) matrix is med grained occasional 25cm cl:	Upper Felsics	megacrystic plagioclase-quartz dacite-lithic breccia
110.44	110.5	Um	Thin Um finger.	Upper Ultramafics	Undifferentiated ultramafic rock, highly altered
110.49	138.3	Fbxm	Same megacrystic volcaniclastic breccia may be a bit coarser grained. coarse grained to very coarse grained by 117m. Abundance of Type 1 clasts increases down hole.	Upper Felsics	megacrystic plagioclase-quartz dacite-lithic breccia
138.33	138.8	Um	Um finger.	Upper Ultramafics	Undifferentiated ultramafic rock, highly altered
138.78	144.9	Fbxm	megacrystic continues as before.	Upper Felsics	megacrystic plagioclase-quartz dacite-lithic breccia
144.85	145.0	Um	Um finger seems to penetrate underlying Fbx - wrapping around clasts.	Upper Ultramafics	Undifferentiated ultramafic rock, highly altered
145.02	145.2	Fbxm	megacrystic volcaniclastic breccia.	Upper Felsics	megacrystic plagioclase-quartz dacite-lithic breccia
145.21	145.8	Um	Um finger. Nice 2-8mm lg vesicles. As always bound by sharp contacts. vesicles concentrated in lowest half.	Upper Ultramafics	Undifferentiated ultramafic rock, highly altered
145.75	147.6	Fbxm	megacrystic volcaniclastic breccia.	Upper Felsics	megacrystic plagioclase-quartz dacite-lithic breccia
147.55	148.6	Um	Um finger.	Upper Ultramafics	Undifferentiated ultramafic rock, highly altered
148.63	148.9	Fbxm	megacrystic volcaniclastic breccia.	Upper Felsics	megacrystic plagioclase-quartz dacite-lithic breccia
148.89	149	Um	Um nose - doesn't penetrate core.	Upper Ultramafics	Undifferentiated ultramafic rock, highly altered

Hole: **BSD044**

From	To	Rocktype	Description	Strat pos	Expanded rock name
148.97	150	Fbxm	megacrystic volcaniclastic breccia.	Upper Felsics	megacrystic plagioclase-quartz dacite-lithic breccia
149.95	154.5	UKSp	weakly preserved random blades, coarsening down hole	Lower Ultramafic	Spinifex textured komatiite, pyroxene spinifex A2
154.5	159.8	UoC	weathered and fractured, dissem chromite	Lower Ultramafic	Olivine cumulate, undifferentiated
159.8	161.5	UKSp	random	Lower Ultramafic	Spinifex textured komatiite, pyroxene spinifex A2
161.5	163	Um	weathered and fractured, dissem chromite	Lower Ultramafic	Undifferentiated ultramafic rock, highly altered
163	210	UoOCbc	grey TALC-CB, equant to bladed olivines 2x5-10mm	Lower Ultramafic	Olivine orthocumulate, bimodal, >6mm olivine,
210	240	UoC	massive grey no texture v sparse chromite	Lower Ultramafic	Olivine cumulate, undifferentiated
240	257	UoOCbc?	faint blotchy texture	Lower Ultramafic	Olivine orthocumulate, bimodal, >6mm olivine
257	261	UoOCbc	aligned 1-2x3-8 mm olivines, bladed to hopper in ?antig-chlorite-carb	Lower Ultramafic	Olivine orthocumulate, bimodal, >6mm olivine,
261	268	UoOCbc	faint blotchy texture	Lower Ultramafic	Olivine orthocumulate, bimodal, >6mm olivine,
268	275	UoC	coarse p'blastic talc-cb, moderately fractured and oxidised, no texture	Lower Ultramafic	Olivine cumulate, undifferentiated
275	284	UoOCs[$]	poorly preserved texture, scattered sub-lob chromite, dissem interst $.	Lower Ultramafic	Olivine orthocumulate, sago, disseminated sulfide
284	305	UoMCc[$]	heavily dissem interst $, 3-7mm sago olivine	Lower Ultramafic	Olivine mesocumulate, undifferentiated, >6mm olivine, d$
305	317.6	UoOCs[$]	dissem sub-lob chromite grading to white bleached carbonate-quartz	Lower Ultramafic	Olivine orthocumulate, sago, disseminated sulfide
317.6	319	UoOCbc	black carbonate-quartz after 2x5-12mm bladed olivine orthocumulate	Lower Ultramafic	Olivine orthocumulate, bimodal, >6mm olivine,
319	320.2	Ibx	fine grained black quartz-cb with possible spherical vesicles		plagioclase dacite-lithic breccia
320.15	324.1	IL	No real alt zone to speak of. II, FW lithology.	Footwall Felsics	plagioclase dacite
324.1	324.7	Ibxw	Intensely welded "autobreccia" horizon (has a "heterolith" look with darker clasts).	Footwall Felsics	clast-deformed plagioclase dacite-lithic breccia
324.7	335	IL	Il with FW lithology as before - heavily veined by carb/quartz (particularly between 332.65-333.65m).	Footwall Felsics	plagioclase dacite
335	335.8	Um	Sharp contact with Um, fine grained at contact, faint feathery interior, fuchsite + chlorite a sharp contacts.	Footwall Felsics	Undifferentiated ultramafic rock, highly altered
335.75	340	IL	EOH. Il again until EOH.	Footwall Felsics	plagioclase dacite

Hole: **BSD044A**

From	To	Rocktype	Description	Strat pos	Expanded rock name
177.8	182	UoOCbc	blotchy grey TALC-CB, sparse sub-lob chromite	Lower Ultramafic	Olivine orthocumulate, bimodal, >6mm olivine,
182	187	UoC	coarse p'blastic talc-carb, no texture	Lower Ultramafic	Olivine cumulate, undifferentiated

Hole: BSD044A

From	To	Rocktype	Description	Strat pos	Expanded rock name
187	205.1	no core			
205.1	214	UoC	bleached, pale fuchsitic tint	Lower Ultramafic	Olivine cumulate, undifferentiated
214	230	UoOCbc	2-10 mm olivines, patchily preserved, dissem sub-lob chromite, v faint texture	Lower Ultramafic	Olivine orthocumulate, bimodal, >6mm olivine,
230	279.2	UoOCbc	typical grey talc-cb, carbonate rich patches,15 mm talc-chlorite blotches after probably coarse olivine	Lower Ultramafic	Olivine orthocumulate, bimodal, >6mm olivine,
279.2	286	UoC	bleached and heavily fractured	Lower Ultramafic	Olivine cumulate, undifferentiated
286	291	UoC	patchy p'blastic carb, 1-2 cm talc-chlorite patches, strongly fractured	Lower Ultramafic	Olivine cumulate, undifferentiated
291	293	UoC	strongly bleached and fractured	Lower Ultramafic	Olivine cumulate, undifferentiated
293	302	UoOCsc	patchy preservation of 2-7mm olivines, dissem sub-lob chromite	Lower Ultramafic	Olivine orthocumulate, sago, >6mm olivine,
302	350	UoOCbc[$]	3-5mm equant olivine interst dissem $ tr lob-poik chromite, 1mm interst chlorite patches, occasional elongate 10mm olivine pheno	Lower Ultramafic	Olivine orthocumulate, bimodal, >6mm olivine, disseminated sulfide
350	355.8	UoOCs	bleached, faint texture disappearing, sharp reaction front at base	Lower Ultramafic	Olivine orthocumulate, sago,
355.8	359	UoOCbf	black carbonate-quartz, 1-3mm, fine bladed ol fining downward	Lower Ultramafic	Olivine orthocumulate, bimodal, <2mm olivine,
358.95	359	Contact	Sharp contact between Um (medium to coarse grained) and FW lv.	Footwall Felsics	
358.95	369.5	Ibx-IL	Ibx interleaved with (1-2m thick) co intervals, FW lithology	Footwall Felsics	plagioclase dacite-lithic breccia and plagioclase dacite
369.5	377	Ibx-IL	EOH. Predom co possibly with thin autobreccia horizons. Lowest 70cm heavily veined and sheared.	Footwall Felsics	plagioclase dacite-lithic breccia and plagioclase dacite

Hole: BSD045

From	To	Rocktype	Description	Strat pos	Expanded rock name
81	137	UoOCbc	pale grey p'blastic TALC-CB after UOOC, dissem chromite, anhed-lob, patches 3-5mm relic texture, weakly aligned olivines, scattered 5-7mm equant hopper grains	Lower Ultramafic	Olivine orthocumulate, bimodal, >6mm olivine,
137	145	UoMCm	grey TALC-CB after 3-5mm unaligned coarse grained mesocum, sparse dissem chromite, anhedr	Lower Ultramafic	Olivine mesocumulate, undifferentiated, 2-6mm olivine
145	170	UoOCbc	as previous unit, mainly elongate olivines, 2-3x5-8mm weakly aligned, sparse dissem anhed chromite	Lower Ultramafic	Olivine orthocumulate, bimodal, >6mm olivine,
170	230	UoOCbc	moderate carbonate veining, fine grained p'blastic carb, patches faint coarse OOC texture as above. Intense Fault 195.5-196, 212-214, 226-230	Lower Ultramafic	Olivine orthocumulate, bimodal, >6mm olivine,
230	240.5	UoOCsm	pale grey TALC-CB, fine carb, abundant dissem chromite, faint 2-4mm sago OOC	Lower Ultramafic	Olivine orthocumulate, sago, 2-6mm olivine,
240.5	246.8	UoOCbf	chloritic coarse grained TCC, <1x2-4mm bladed olivines in liquid-rich OOC	Lower Ultramafic	Olivine orthocumulate, bimodal, <2mm olivine,
246.8	249	UoOCsm	quartz-carbonate after 2-4mm sago OOC	Lower Ultramafic	Olivine orthocumulate, sago, 2-6mm olivine,
249	249.7	UKM?	coarse grained chlorite-carbonate-talc-cb after UKM or liquid-rich OOC, fining down to lower contact	Lower Ultramafic	
249.74	249.8	RZ	Contact: chlorite'	HW/FW?	

Hole: BSD051

From	To	Rocktype	Description	Strat pos	Expanded rock name
162.2	174.4	Fi-alkaline	Typical pale-pale green, very fine grained, sparsely plagioclase phyric coherent rock with pyrite cubes - bounded by sharp contact, feldsparspathoid bearing unit? Heavily veined by quartz. Thin Um unit 174.4-176.35m.	Upper Felsics	scarce feldspar micro-toscanite
174.4	176.4	Um	fractured, weathered	Lower Ultramafic	Undifferentiated ultramafic rock, highly altered
176.35	177.6	Fi-alkaline	Weathered and veined and broken core but look like an interval of rock identical to 162.1-174.4m, Pale green sparsely plagioclase phyric fine grained rock bounded by sharp chloritized contacts.	Upper Felsics	scarce feldspar micro-toscanite
177.6	224	UoC	porphyroblastic, mildly weathered, grading to fresh porphyroblastic talc carbonate, blotchy after possibly pheno olivine	Lower Ultramafic	Olivine cumulate, undifferentiated
224	231.7	UoOC	porphyroblastic, 2-4mm carbonate filled vesicles/vesicles	Lower Ultramafic	Olivine orthocumulate, undifferentiated
231.7	251	UoOC	blotchy porphyroblastic pink grey, no texture preserved, poss faint porphyritic olivine ghosts	Lower Ultramafic	Olivine orthocumulate, undifferentiated
251	254	UoOCsc	5-7mm ovoid olivine, dissem subhedral-lobate chromite .5-1mm	Lower Ultramafic	Olivine orthocumulate, sago, >6mm olivine,
254	271	UoOCsm[$]	dissem interstitial $, 2-6mm sago olivine, dissem subhedral-lobate chromite .5mm	Lower Ultramafic	Olivine orthocumulate, sago, 2-6mm olivine, disseminated sulfide
271	273.9	UoOC	massive whit, no texture preserved, no $	Lower Ultramafic	Olivine orthocumulate, undifferentiated
273.9	276.4	UoOCbc	2-5mm olivine with abundant strongly aligned 1x10mm bladed olivine phenos, strongly aligned in dark grey carbonate-quartz rock, sharp contact (sampled, 276.3) with next	Lower Ultramafic	Olivine orthocumulate, bimodal, >6mm olivine,
276.4	276.8	UoOChf	fine UOOC with abundant fine bladed, hopper and chevron cumulus olivine .5-2mm, decreasing grain size to contact	Lower Ultramafic	Olivine orthocumulate, hopper olivine <2mm olivine,
276.8	310	IL	Very dark grey right below contact w/ UM, coherent FW-felsic interval shows foliation, core lightens to pale greenish grey to EOH. Sample BSD51 - 276.65m - analysis is Um & petrographically looks like a harrisite	Footwall Felsics	plagioclase dacite
276.8	276.8	Contact	Contact between UM cumulate (ooc?) and an apparently coherent FW-felsic unit.	Upper Felsics	

Hole: BSD052

From	To	Rocktype	Description	Strat pos	Expanded rock name
0	99	precollar			
99	115.2	UoOCsm	coarse 3-6mm sago in dark grey talc-carbonate	Upper Ultramafics	Olivine orthocumulate, sago, 2-6mm olivine,
115.2	117.4	UKM	poorly preserved texture, weak bladed texture	Upper Ultramafics	Komatiite flow margin, qtz-chlor-carb, no texture
117.4	117.9	Ft	Fine-grained crystal-rich unit (up to 90% crystals in places): <5mm lithic and crystal fragments	Upper Felsics	crystal tuff
117.9	123.5	Fbxm	volcaniclastic breccia w/ predominantly clasts w/ 20-30% (some up to 75%!) modal phenos (pl: 1mm-8mm) matrix: <5mm lithic and crystal fragments, crystal-rich horizons (up to 90% crystals), Glomerocrysts in clasts up to 15mm, matrix supported, clasts 3-16cm	Upper Felsics	megacrystic plagioclase-quartz dacite-lithic breccia
123.45	123.6	Um	15 mm thick um vein, strongly chloritized - faint rounded blebs irregular inclusions of plagioclase phyric felsics up to 2mm.	Upper Felsics	Undifferentiated ultramafic rock, highly altered
123.6	144.1	Fbxm	Same as 117.9-123.45 m except clasts 2-28cm, ~130.5-130.7m reversely graded matrix 1-2mm to sub mm (xl-rich) in gen matrix finer 2-3mm, thick carbonate and quartz veins + py, xl-rich clasts increase in last 4 m as does veining and matrix <2mm	Upper Felsics	megacrystic plagioclase-quartz dacite-lithic breccia

Hole: ***BSD052***

From	*To*	*Rocktype*	*Description*	*Strat pos*	*Expanded rock name*
144.1	144.8	UKS	fine grained flow top, coarse UKS invading fractures in finer flow top material	Lower Ultramafic	Spinifex textured komatiite, undifferentiated
144.8	151	UKSo	weathered, poorly preserved texture, faint 2 cm random olivine blades	Lower Ultramafic	Spinifex textured komatiite, olivine spinifex
151	160	UoOChc	1 cm hopper grains, coarsely p'blastic talc-carbonate, dissem. sub-to euhedral chromite ~1mm, poorly preserved texture	Lower Ultramafic	Olivine orthocumulate, hopper olivine >6mm olivine,
160	210	UoOCsc/UoOCbc	interlayered, mainly 3-7 mm olivines, dissem. sub-to euhedral chromite ~1mm, faint blotching after unaligned olivine, poorly preserved texture throughout	Lower Ultramafic	
210	230	UoOCbc	typical, poorly preserved texture in light grey mottled talc-carbonate, fine dissem. sub-to euhedral chromite ~.5 mm	Lower Ultramafic	Olivine orthocumulate, bimodal, >6mm olivine,
230	256	UoOC	grey p'blastic talc-carbonate, no texture, dissem. sub-to euhedral chromite .5mm	Lower Ultramafic	Olivine orthocumulate, undifferentiated
256	263	no core			
263	284	UoOCbm[$]	heterogeneous olivine grain size, mixed 1-2 and 3-6mm grains, sago, subequant grains, fine grained dissem. sub-to euhedral chromite, 1-5% dissem interstitial $, coarsening to 1cm subspherical blebs below 275m	Lower Ultramafic	Olivine orthocumulate, bimodal, 2-6mm olivine, disseminated sulfide
284	288	UoOCbf	2-5mm sago olivine with minor 5mm bladed grains, sparse dissem $	Lower Ultramafic	Olivine orthocumulate, bimodal, <2mm olivine,
288	313.9	UoOCsc[$]	3-7mm olivine, 2-10mm interstitial and coarse subspherical $ blebs, dissem subhedral to lobate chromite to 1mm	Lower Ultramafic	Olivine orthocumulate, sago, >6mm olivine, disseminated sulfide
313.85	323.4	$Mrfp	bands of py + po around ovoid chloritic inclusions, patches of py+cpy in ribbon textured pen+po	Lower Ultramafic	Massive sulfide, ribbon textured, felsic plumes
323.4	325.5	F/Um	veined pale grey carbonate-silica rock, brecciated ovoid clasts, arsenide + cpy veinlets and bands		Felsic or ultramafic?
325.53	326.5	$M/MZ	heterogeneous mixed zone chloritic silicate with inclusions and massive sulfide	Lower Ultramafic	
326.5	328.5	$Mrfp	pen + po, minor bands of cpy with chloritic silicate inclusions	Lower Ultramafic	Massive sulfide, ribbon textured, felsic plumes
328.48	339.5	lbx-lbxw	FW volcaniclastic breccia with carbonate alt, 0.5-20cm clasts, clast supported to matrix supported, matrix fine grained and heavily alt (carb), clasts w/ sericitized plagioclase (<2mm up to 10% plagioclase phenos), slight deformation-alignments, alternating zones of coarse to very coarse grained with medium grained intervals	Footwall Felsics	plagioclase dacite-lithic breccia and clast-deformed breccia
339.5	340.9	lbxw	FW-volcanic breccia	Footwall Felsics	clast-deformed plagioclase dacite-lithic breccia
340.9	347.3	lbxw	Welded-stretched volcaniclastic breccia, alternating coarse to very coarse grained with medium to coarse grained intervals, ends at 347.3. 2 clast types - typical grey plagioclase phyric and dk brown altered clasts.(Thor notes that these are often vesic?), may be collapsed pum?? Dom matrix supported.	Footwall Felsics	clast-deformed plagioclase dacite-lithic breccia
347.3	352	Um	Um	Footwall Felsics	Undifferentiated ultramafic rock, highly altered
352	367	lbxw	medium grained and coarse to very coarse grained intervals continues as does welding (but goes strong to incipient), increase in dark/welded wispy clasts (collapsed pumice?), @ 359.2m starting to "look" more polymict but lithologically looks identical, matrix gs incr at 364	Footwall Felsics	clast-deformed plagioclase dacite-lithic breccia

Hole: ***BSD052A***

Hole: BSD078

From	To	Rocktype	Description	Strat pos	Expanded rock name
320	365	UoOC	close packed olivine, very poorly preserved texture in dark grey porphyroblastic talc carbonate	Lower Ultramafic	Olivine orthocumulate, undifferentiated
365	408	UoMCsm/UoMCbc	medium-gr ovoid olivine, mainly 1-4mm with minor 5-7mm bladed grains, rare hopper phenos, v fine dissem subhedral-lobate chromite, grain size layered on scale of several m	Lower Ultramafic	
408	409	UoMCbc	strongly aligned elongate olivine to 1 cm	Lower Ultramafic	Olivine mesocumulate, bimodal, >6mm olivines
409	441.9	UoMCsf	as above, 1-3mm equant olivine, 1-2mm lobate to poikilitic chromite, mainly pale grey-green carbonate-quartz, bleached and heavily carbonate veined towards lower contact	Lower Ultramafic	Olivine mesocumulate, sago textured, <2mm olivine
441.85	453.5	Fbx	coarse to very coarse grained, clast supported, volcaniclastic breccia, clasts size: 10-30 cm (r: 3-80 cm); monomict w/2 clast types: (1) feldspar. (</=5%, <2mm); (2) feldspar (20-35%,</=10mm) +/-megacrysts; rare quartz (<2%,</=3 mm), medium grained matrix (coglith + xtals); py, disp+2.5 cm blob (<1%); heavily fractured in top 2m.	Footwall Felsics	plagioclase-quartz dacite-lithic breccia
453.5	472.7	Ft	d gray, st alt, fine grained, co-looking xtal - li tuff. St sheared + frag, w/1-10 cm thick mylonite horiz, numerous carb+quartz veins.	Footwall Felsics	crystal tuff

Hole: BSD079

From	To	Rocktype	Description	Strat pos	Expanded rock name
0	84.2	precollar	precollar	Upper Felsics	
84.2	90.6	UKS/MBS	buff to green grey, co, fine grained, spx (wormy pseudo-bladed) textured Um/M lava flow; intensely carbonated	Upper Ultramafics	
90.6	96.85	UKS/MBS	green grey, very fine grained, spx textured Um/M lava flow as above; heavily veined , possible original polygonal jointing	Upper Ultramafics	
96.85	96.85	Contact	sharp transition	Upper Felsics	
96.85	113.6	MBSbx	medium to coarse grained, ultramafic volcaniclastic breccia w/very fine grained spx textured clasts, flow-top breccia or hyaloclastite, heavily altered to fine grained yellow-green carbonate, possible stretched vesicles at 98.5 & 2-10mm flattened clasts in homog chloritic matrix in lowest 1.7m	Upper Ultramafics	Basaltic flow top bx
113.6	113.6	Contact	sharp transition	Upper Felsics	
113.6	113.9	UKSo	med-grained random olivine spinifex, facing up hole	Upper Ultramafics	Spinifex textured komatiite, olivine spinifex
113.9	114.3	UKSo	coarse A3 books, 90deg to core axis	Upper Ultramafics	Spinifex textured komatiite, olivine spinifex
114.3	116.4	UKM	massive fine to grained unit, bx in places, ? flow top	Upper Ultramafics	Komatiite flow margin, qtz-chlor-carb, no texture
116.4	116.5	UKSo	fine grained A1-A2	Upper Ultramafics	Spinifex textured komatiite, olivine spinifex
116.5	118.9	UKSo	coarse A3, 60deg to core axis, facing up hole	Upper Ultramafics	Spinifex textured komatiite, olivine spinifex
118.9	119.8	UKM	chl-quartz-serp after possible B zone, no texture	Upper Ultramafics	Komatiite flow margin, qtz-chlor-carb, no texture
119.8	120.8	UKM	fine grained flow top	Upper Ultramafics	Komatiite flow margin, qtz-chlor-carb, no texture
120.8	120.9	UKS	fine grained flow top with coarsening random olivine spinifex, facing up hole	Upper Ultramafics	Spinifex textured komatiite, undifferentiated

Hole: BSD079

From	To	Rocktype	Description	Strat pos	Expanded rock name
120.9	122.3	UKS	coarse A3 books	Upper Ultramafics	Spinifex textured komatiite, undifferentiated
122.3	124.4	UKS	fine grained flow top with coarsening random olivine spinifex, facing up hole	Upper Ultramafics	Spinifex textured komatiite, undifferentiated
124.4	130	UKMbx	textureless chloritic bx unit with felsic clasts	Upper Ultramafics	Komatiite flow margin, brecciated
130	134.5	Um?			
134.5	139.2	UKSp	fine grained a1-a2 flow top and fine random spinifex with v extensive quartz-carbonate veining	Upper Ultramafics	Spinifex textured komatiite, pyroxene spinifex A2
139.2	139.7	UKSp	very fine grained random a1 with <5% $ associated w broken carbonate veins	Upper Ultramafics	Spinifex textured komatiite, pyroxene spinifex A2
139.7	142.3	UKSp	a1/a2 random pyroxene, brecciated, fine grained	Upper Ultramafics	Spinifex textured komatiite, pyroxene spinifex A2
142.3	144.2	Um	heavily veined and carbonated - Cr rich, must be Um		Undifferentiated ultramafic rock, highly altered
144.2	144.4	UKSo	very fine grained a1 w extensive veining	Upper Ultramafics	Spinifex textured komatiite, olivine spinifex
144.4	144.5	UKSo	a3 olivine books	Upper Ultramafics	Spinifex textured komatiite, olivine spinifex
144.5	144.8	UoOC	b zone very fine grained sago olivine, sinuous contact close to core axis with overlying a zone, probably folded	Upper Ultramafics	Olivine orthocumulate, undifferentiated
144.8	145.3	UKSo	spectacular a2-a3 olivine books	Upper Ultramafics	Spinifex textured komatiite, olivine spinifex
145.3	147.2	UoOCf	1-2mm b zone olivine, heavy quartz-carbonate veining	Upper Ultramafics	Olivine orthocumulate, <2mm olivine,
147.2	151	UKSo	coarse a3 books, carbonate veined and folded on cm scale	Upper Ultramafics	Spinifex textured komatiite, olivine spinifex
151	155	UoOCsf	fine grained b zone	Upper Ultramafics	Olivine orthocumulate, sago, <2mm olivine,
155	186.3	UoOCsf	1-2mm sago olivine, very fine grained euhedral chromite, faint texture	Upper Ultramafics	Olivine orthocumulate, sago, <2mm olivine,
186.3	189.3	UoC	strongly sheared, schistose, strong foliation near parallel to core	Upper Ultramafics	Olivine cumulate, undifferentiated
189.3	190	UKS/rz	d green gray, very fine grained, random spx textured Um w/dispersed ol phenos, replaced by chlorite & carb	Upper Ultramafics	
190	190	Contact	indistinct contact	Upper Felsics	
190	193.5	FaPP	undeformed, d gray f. gr., porphyritic, co intrusion or lava (?), w/10-20% of </=2mm plagioclase phenocrysts & <5% relict mafic phenocrysts	Upper Felsics	amphibole plagioclase porphyry
193.45	195.7	UKM/UKS	bleached, relict ol xtals (1-15mm; 30-50%), in spx textured groundmass; intense fine-scale carbonate veining	Upper Ultramafics	Komatiite flow margin, possible faint spinifex texture
193.45	193.5	Contact	sharp contact	Upper Felsics	
195.7	196.4	UoOCsf	b zone	Upper Ultramafics	Olivine orthocumulate, sago, <2mm olivine,

Hole: BSD079

From	*To*	*Rocktype*	*Description*	*Strat pos*	*Expanded rock name*
196.4	198.7	UKM	sheared & veined, chloritized talc-carbonate; relict ol xtals (1-15mm; 30-50%), in spx textured groundmass	Upper Ultramafics	Komatiite flow margin, qtz-chlor-carb, no texture
198.65	198.7	Contact	sharp transition	Upper Felsics	
198.65	222.6	Fbx	medium to coarse grained, clast supported, volcaniclastic breccia w/feldspar (0.2-8mm, typ 1-4mm; 25-35%) and quartz (0.2-5mm; 10-15%, resorbed) phyric clasts; matrix, fine to medium grained, coglith =/-feldspar & quartz xtals; strongly sheared and mylonitic in places	Upper Felsics	plagioclase-quartz dacite-lithic breccia
222.6	222.6	Contact	sharp contact	Upper Felsics	
222.6	266.5	lt	faintly bedded, fine to medium grained crystal tuff; w/feldspar as dominant clast-type (1-10mm; 70-80%), less quartz xtals (<1mm; </=3%) and coglith (10-60mm; </=5%); interval is sheared and deformed in places	Upper Felsics	plagioclase crystal tuff
266.5	267.4	Fbx	strongly sheared, medium grained, clast supported, volcaniclastic breccia w/feldspar (</=4mm; 3-10%) & quartz (<1-2.5mm; </=1-2%) phyric clasts; matrix, very fine grained	Upper Felsics	plagioclase-quartz dacite-lithic breccia
266.5	266.5	Contact	sharp transition	Upper Felsics	
267.35	267.4	Contact	sharp contact	Upper Felsics	
267.35	268	lt	sheared, massive, fine grained, crystal tuff (?), w/feldspar as dominant clast-type(</=2 mm; 75-80%), less quartz xtals (<1mm; <<1%) & siderite a/mafic phase (?) (</=1mm; 10-15%)	Upper Felsics	plagioclase crystal tuff
268	268	Contact	indistinct contact	Upper Felsics	
268	270.8	Fbx	strongly sheared, medium grained, clast supported, volcaniclastic breccia w/feldspar (</=2mm, <10%) phyric clasts; similar to interval 266.5-267.35m	Upper Felsics	plagioclase-quartz dacite-lithic breccia
270.8	271	Contact	indistinct contact	Upper Felsics	
271	272.8	lip	sheared, feldspar phyric (0.3-3.0mm; 25-30%), co intermediate intrusive (Salmon Andesite?); groundmass, fine grained, w/feldspar & chlorite/biot a/mafic phase	Upper Felsics	plagioclase microdiorite
272.8	273.3	lip+RZ	strongly altered and chloritized	Upper Felsics	Quenched+/- chloritized marins of lip
273.3	273.3	Contact	sharp contact	Upper Felsics	
273.3	280	UoC	massive carbonate veined porphyroblastic talc carbonate; no texture preserved	Lower Ultramafic	Olivine cumulate, undifferentiated
280	305	UoOCsc	5-7mm ovoid ol, local v faint texture, coarsely porphyroblastic talc carbonate mainly with no texture preserved, scattered tourmaline grains around 303m	Lower Ultramafic	Olivine orthocumulate, sago, >6mm olivine,
305	307	li			intermediate intrusive, undifferentiated
307	370	UoOCsc	5-7mm ovoid olivine in porphyroblastic talc carbonate	Lower Ultramafic	Olivine orthocumulate, sago, >6mm olivine,
370	375.2	UoC	sheared, carbonate veined, no texture preserved, probably tectonic contact with fractured felsic breccia	Lower Ultramafic	Olivine cumulate, undifferentiated
375.2	375.2	Contact	sharp transition	Footwall Felsics	
375.2	382.2	Fiap	heavily veined & strongly sheared, d gray, fine grained., aphyric, intermediate co lava or intrusive; groundmass, sub-mm, stubby to lath shaped plags & chlorite a/px	Footwall Felsics	aphyric micro-granodiorite
382.2	382.2	Contact	sharp contact	Footwall Felsics	
382.2	382.4	Um	0.2 m. UM-finger? Greenish gray, soft, strongly sheared with sub-mm needle and stubby white crystals in an amorphous-looking material. Also dark brown, sub-mm cubic opaques with brown streak (chromite?).	Footwall Felsics	Undifferentiated ultramafic rock, highly altered

Hole:	BSD079				
From	**To**	**Rocktype**	**Description**	**Strat pos**	**Expanded rock name**
382.4	382.4	Contact	indistinct contact	Footwall Felsics	
382.4	390.1	FaPP	gray, feldspar phyric, co lava or intrusive; w/20-30% of 0.5-3mm plagioclase phenos; very hard rock and heavily veined by quartz, but not sheared.	Footwall Felsics	amphibole plagioclase porphyry
390.1	390.1	Contact	sharp contact	Upper Felsics	
390.1	396	FL	greenish gray, hard, very fine grained, sparsely px phyric, co lava?; w/relict px needles and phenos and bounded by 0.5-1 m thick fragmental horizons (rubble?)	Footwall Felsics	plagioclase-quartz dacite
396	403	Fbx	strongly sheared, coarse grained, matrix supported-clast supported, volcaniclastic breccia, w/feldspar (</=4.0mm ; 3-10%) & quartz (</=4.0mm ; 2-10%) phyric clasts; matrix, medium grained (</=20mm); coglith + quartz & feldspar xtals	Footwall Felsics	plagioclase-quartz dacite-lithic breccia
396	396	Contact	indistinct contact	Footwall Felsics	
Hole:	**BSD080**				
95	99.4	UoC	massive finely p'blastic talc-cb, no texture	Lower Ultramafic	Olivine cumulate, undifferentiated
99.4	99.8	UoOC(Harr)	very coarse 1-2cm branching olivines, weakly preserved texture mainly overprinted by p'blastic carbonate but visible in weathered rock at base of unit. Sample 99.6	Lower Ultramafic	Olivine orthocumulate, harrisitic
99.8	100.8	UoC	weathered p'blastic TALC-CB	Lower Ultramafic	Olivine cumulate, undifferentiated
100.8	120.6	UoOCsm	2-5mm even grained dissem chromite	Lower Ultramafic	Olivine orthocumulate, sago, 2-6mm olivine,
120.6	124.1	UoC	massive fine-grained QC, after ?OOC, sparse dissem chromite and pyrite cubes, v. intensely silicified, pure white	Lower Ultramafic	Olivine cumulate, undifferentiated
124.05	173.5	Fi-alkaline	Pale green fine grained coherent unit , weakly porphyritic w/ disseminated euhedral py	Upper Felsics	scarce feldspar micro-toscanite
173.5	173.5	Contact	Contact: very convoluted and sharp	Upper Felsics	
173.5	174	UoC	after UOC, dissem chromite, no texture, grades to	Lower Ultramafic	Olivine cumulate, undifferentiated
174	182	UoOCbc	more grey fine TALC-CB after UOC with abundant elongate 2x10mm bladed olivines in 2-5mm sago unaligned, dissem chromite	Lower Ultramafic	Olivine orthocumulate, bimodal, >6mm olivine,
182	186	UoC	massive finely p'blastic talc-cb, no texture	Lower Ultramafic	Olivine cumulate, undifferentiated
186	223.3	UoOCbc	after coarse UOOC, porph 1cm olivines, dissem chromite, heavily silicified towards FP contact	Lower Ultramafic	Olivine orthocumulate, bimodal, >6mm olivine,
223.3	223.3	RZ	Contact: fine grained chlorite zone	Upper Felsics	
223.3	224.7	FaPP	Salmon Andesite, salmon pink color, plagioclase and mafic phenos	Upper Felsics	amphibole plagioclase porphyry
224.7	225.6	RZ		Lower Ultramafic	
225.6	226	UoOCsf	2-3mm olivine, <.5mm dissem sub-lobate chromite, grades to	Lower Ultramafic	Olivine orthocumulate, sago, <2mm olivine,
226	228	UoC/UKM	moderately sheared chlorite-rich chlorite-talc-carbonate, possible faint relic bladed texture in places, coarse poik'blastic carb, locally grading to chloritic RZ	Lower Ultramafic	
228	229.5	UoC/UKM	as above, with very intense quartz and carbonate veining and locally strong shearing, probable tectonic shear	Lower Ultramafic	
229.5	229.8	RZ	quartz vein and reaction zone		

Hole: *BSD082*

From	*To*	*Rocktype*	*Description*	*Strat pos*	*Expanded rock name*
0	81	Um	precollar	Black Swan channe	Undifferentiated ultramafic rock, highly altered
81	105	UoOCsf	fine grained 1-3mm olivine, minor dissem subhed-lobate chromite, light grey-pink talc-cb	Black Swan channe	Olivine orthocumulate, sago, <2mm olivine,
105	144.6	UoOCsm	rare coarse blade olivine phenos in typical 2-5mm OC, grey p'blastic talc-carbonate, poorly preserved texture, 1mm minor dissem subhed-lobate chromite, occasional possible spinifex veins	Black Swan channe	Olivine orthocumulate, sago, 2-6mm olivine,
144.6	144.9	UoOC(Harr)	poorly preserved texture, coarse bladed olivine random to 2cm within OC	Black Swan channe	Olivine orthocumulate, harrisitic
144.9	155.8	UoC	fine p'blastic medium grey talc-cb, carbonate veining, no texture	Black Swan channe	Olivine cumulate, undifferentiated
155.8	165	UoOCbc	mainly 5-8mm subequant with 1cm bladed grains, weakly aligned, 0.5mm minor dissem sub-euhedral chromite, light grey cb-talc-cb-quartz	Black Swan channe	Olivine orthocumulate, bimodal, >6mm olivine,
165	165.2	UKSV	coarse random olivine books in vein with sharp contacts both sides	Black Swan channe	Spinifex trextured veins, irregular, crosscutting cumulates
165.2	177	UoOCbc	mainly 5-8mm subequant with 1cm bladed grains, weakly aligned, 0.5mm minor dissem sub-euhedral chromite, numerous thin intruded spinifex veins, avge 50cm spacing, containing coarse 1-3cm olivine plates, subparallel to layering	Black Swan channe	Olivine orthocumulate, bimodal, >6mm olivine,
177	188	UoC	coarse p'blastic talc-carbonate, abundant carbonate veining, no texture, occasional spinifex veins	Black Swan channe	Olivine cumulate, undifferentiated
188	190.6	UoOCbc	mainly 5-8mm subequant with 1cm bladed grains, weakly aligned, 0.5mm minor dissem sub-euhedral chromite, numerous thin intruded spinifex veins, avge 50cm spacing, containing coarse 1-3cm olivine plates, subparallel to layering	Black Swan channe	Olivine orthocumulate, bimodal, >6mm olivine,
190.6	190.7	UKSV	spinifex vein with 2cm bladed olivine, sharp contacts both sides	Black Swan channe	Spinifex trextured veins, irregular, crosscutting cumulates
190.7	227	UoOCbc	mainly 5-8mm subequant with 1cm bladed grains, weakly aligned, 0.5mm minor dissem sub-euhedral chromite, numerous thin intruded spinifex veins, avge 50cm spacing, containing coarse 1-3cm olivine plates, subparallel to layering	Black Swan channe	Olivine orthocumulate, bimodal, >6mm olivine,
227	233	UoMCbc	4-7mm close-packed olivine with bladed grains to 1cm, flow aligned, well preserved texture, minor dissem subhed-lobate chromite ~1mm, irregular lobate 1-5cm patches fine grained interst melt forming layer-parallel "mini-harrisite" layers	Black Swan channe	Olivine mesocumulate, bimodal, >6mm olivines
233	250	UoOCbc	Grain size fluctuation from 4-8 to 1-4mm UOOCs with blade olivine phenos to 1 cm, spinifex veins spaced 2-4m, antig-carbonateonate with patches talc-cb	Black Swan channe	Olivine orthocumulate, bimodal, >6mm olivine,
250	266	UoOCbc	5-7mm subequant olivine, well preserved texture, 1 cm bladed aligned phenos	Black Swan channe	Olivine orthocumulate, bimodal, >6mm olivine,
266	270	UoMCbm	2-5mm close packed olivine, otherwise as above	Black Swan channe	Olivine mesocumulate, bimodal, 2-6mm olivine
270	282	UoOCbc	alternation of last two rock types on 20-40cm scale	Black Swan channe	Olivine orthocumulate, bimodal, >6mm olivine,
282	300	UoOCbc	pale grey talc-cb, poorly preserved texture to no texture	Black Swan channe	Olivine orthocumulate, bimodal, >6mm olivine,
300	370	UoC	occasional spinifex veins in dark grey p'blastic talc-carbonate, no texture	Black Swan channe	Olivine cumulate, undifferentiated
370	403	UoOCbc	faint ghost of aligned olivine texture in p'blastic talc-carbonate, 5-10mm olivine, scattered euhedr and lob chromite with fine interst oikocryst-like patches of chlorite+hematite	Black Swan channe	Olivine orthocumulate, bimodal, >6mm olivine,

Hole: *BSD082*

From	*To*	*Rocktype*	*Description*	*Strat pos*	*Expanded rock name*
403	407	UoOCbc	5-7mm olivine with 1 cm bladed aligned phenos	Black Swan channe	Olivine orthocumulate, bimodal, >6mm olivine,
407	425	UoC	coarse p'blastic talc-carbonate, no texture, rare spinifex veins	Black Swan channe	Olivine cumulate, undifferentiated
425	439	UoOCbc	5-7mm olivine with 1 cm bladed aligned phenos, intermittently preserved in light grey talc-cb, minor patches antig-carbonate	Black Swan channe	Olivine orthocumulate, bimodal, >6mm olivine,
439	447	UoOChc	1-2cm coarse hopper and bladed olivine, strongly flow aligned, sparse scattered 1mm euhedr chromite	Black Swan channe	Olivine orthocumulate, hopper olivine >6mm olivine,
447	452	UoOChc[$]	few % 2-20mm irregular convex to subspherical composite silicate-$ blebs, rare patches preserved olivine texture in mainly textless grey talc-cb	Black Swan channe	Olivine orthocumulate, hopper olivine >6mm olivine, disseminated sulfide
452	473.4	UoOChc[$]	very poorly preserved texture, p'blastic grey talc-cb, no $, alternating on few-m scale with blebby sulphide-bearing material as above	Black Swan channe	Olivine orthocumulate, hopper olivine >6mm olivine, disseminated sulfide
473.4	474.5	UoOC(harr) vesic	as above with 5% of 5-10mm subspherical to rarely interstitial carbonate-filled vesicles, no $	Black Swan channe	Olivine orthocumulate, harrisitic, vesicular, >6 mm olivine
474.5	504	UoOChc	very poorly preserved texture in p'blastic talc-carbonate, as above, minor dissem sub-euhedral chromite	Black Swan channe	Olivine orthocumulate, hopper olivine >6mm olivine,
504	516	no core			
516	566	UoOCbc	3-7mm with 1cm blades, variable grain size, scattered sub-lob chromite to 3mm, mainly ~1mm, poorly preserved texture in variably carbonated TALC-CB and CTQ, locally with strong haematitic staining	Black Swan channe	Olivine orthocumulate, bimodal, >6mm olivine,
566	566.2	RZ	Contact lost in ~20cm chloritized zone	Upper Felsics	
566.2	568.2	Fi-alkaline	Coherent fine grained HW unit ~11cm thick quartz vein cuts unit near center, mottled appearance obscuring texture, may be related to the fine grained pale HW unit (feldsparspathoid bearing unit), sparse recrystallized quartz crystals	Upper Felsics	scarce feldspar micro-toscanite
568.2	568.4	RZ	Contact lost in ~20cm chloritized zone	Upper Felsics	
568.4	582	UoOCbc	very poorly preserved texture in carbonate-rich light grey talc-cb, minor dissem subhed-lobate chromite	Black Swan channe	Olivine orthocumulate, bimodal, >6mm olivine,
582	586	UoC	p'blastic talc-carbonate dark grey, coarse carbonate, no texture	Black Swan channe	Olivine cumulate, undifferentiated
586	602	UoOCbc	coarse p'blastic grey talc-cb, poorly preserved texture, minor dissem subhed-lobate chromite	Black Swan channe	Olivine orthocumulate, bimodal, >6mm olivine,
602	629	UoOCsm	p'blastic talc-carbonate, poorly preserved texture, occasional small patches sago OC texture, 3-5mm grains, minor dissem subhed-lobate chromite, 1mm grains partially replaced by chlorite	Black Swan channe	Olivine orthocumulate, sago, 2-6mm olivine,
629	631	UoOCbc	fine 1-3mm sago olivine with 1x5mm bladed olivine, flow aligned, dissem fine euhedr chromite	Black Swan channe	Olivine orthocumulate, bimodal, >6mm olivine,
631	637	UoC	p'blastic talc-carbonate dark grey, coarse carbonate, no texture	Black Swan channe	Olivine cumulate, undifferentiated
637	652	UoOCbc	3-6mm with 1cm aligned blades, typical, finer grained interlayers on 50cm scale, fine minor dissem sub-euhedral chromite	Black Swan channe	Olivine orthocumulate, bimodal, >6mm olivine,
652	668	UoC	p'blastic talc-carbonate dark grey, coarse carbonate, no texture	Black Swan channe	Olivine cumulate, undifferentiated
668	687.3	UoOCbc	3-5mm plus 1cm bladed, typical, grey p'blastic talc-carbonate, minor dissem subhed-lobate chromite	Black Swan channe	Olivine orthocumulate, bimodal, >6mm olivine,
687.3	687.3	RZ	Contact sharp and chloritized (4-10cm thick chloritized zone)	Upper Felsics	

Hole: **BSD082**

From	To	Rocktype	Description	Strat pos	Expanded rock name
687.3	691.9	FbPP	Coherent, pheno-rich intermediate rock, stained to dark chloritic green at either contact (50-80cm of core), pheno mode: 40-50vol%, dominated by feldspar, and lesser chloritized mafics mafic possibly replaced by carbonate in the interior	Upper Felsics	biotite plagioclase porphyry
691.85	691.9	RZ	Contact sharp and chloritized (4-10cm thick chloritized zone)	Upper Felsics	
691.85	706	UoOCsm	3-5mm olivine, finer grained interlayers, minor dissem subhed-lobate chromite	Black Swan channe	Olivine orthocumulate, sago, 2-6mm olivine,
706	725	UoOCsm	2-5mm, euhedr chromite to 1mm, locally up to 1% over few cm, chromite euhedral where more abundant, otherwise lobate, patches trellis veined p'blastic talc-carbonate, no texture	Black Swan channe	Olivine orthocumulate, sago, 2-6mm olivine,
725	733.4	UoOCbc	as above but fining down to 2-3mm olivine, fine bladed grains, <1mm euhedr chromite, cumulates directly to contact	Black Swan channe	Olivine orthocumulate, bimodal, >6mm olivine,
733.4	733.5	qv			
733.45	733.5	Contact	Sharp	HW/ FW	
733.45	745.9	IL	Coherent, plagioclase phenos (dom) mode </=5-10vol%, dispersed pyrite cubes (</=5mm) </=5vol% and fine veinlets with dissem pyrite, deformation (shearing) visible in rock (systematic alignment of plagioclase phenos)	Footwall Felsics	plagioclase dacite
745.85	745.9	Contact	Contacts with above unit very sharp and unaltered	Footwall Felsics	
745.85	750.4	FbPP	Salmon Andesite? Coherent, kaolin to reddish pink plagioclase phyric rock, possibly salmon andesite, plagioclase phenos (</=30vol%, </=3mm), possible mafics.. *Sample BSD82 - 747.75m.	Footwall Felsics	biotite plagioclase porphyry
750.4	750.4	Contact	Contact with underlying unit very sharp and unaltered	Footwall Felsics	
750.4	755.8	IL	Identical to interval 733.45-745.85m.	Footwall Felsics	plagioclase dacite
755.8	756.8	IL	very fine grained, pale green coherent rock, seen units similar to this in FW, chemically like other FW rocks.	Footwall Felsics	plagioclase dacite
755.8	755.8	Fault	contact sharp, irregular, in broken core	Footwall Felsics	
756.8	760	IL	Similar to intervals 733.45 and 750.4m except for <1m below upper contact, where it is veined and altered. Contains several clasts, some very strongly deformed. Possible xenoliths in lava?	Footwall Felsics	plagioclase dacite
756.8	756.8	vein	Veined at sharp, irregular contact	Footwall Felsics	

Hole: **BSD083**

From	To	Rocktype	Description	Strat pos	Expanded rock name
87	101.1	UoOCs, UoOCbf	poorly preserved texture in grey p'blastic talc-carbonate, mainly 3-5mm olivine, locally bladed/aligned, dissem. sub-to euhedral chromite <.5mm	Upper Ultramafics	
101.1	107	UKSp	flow breccia, patchily preserved random A1/A2 needles, fluctuating grain size in highly fractured flow top with abundant quartz-carbonate veining in yellow/green/grey carbonate-chlorite-quartz-, coarse blebby and euhedral pyrite dissem below 105	Upper Ultramafics	Spinifex textured komatiite, pyroxene spinifex A2
107	112.3	UoOCsf	fine grained B zone, 1-3mm hopper olivine, weakly dissem blebby pyrite	Upper Ultramafics	Olivine orthocumulate, sago, <2mm olivine,
112.3	113.7	UoC	weathered	Upper Ultramafics	Olivine cumulate, undifferentiated
113.7	114.1	UKSp	flow top, polygonally jointed, v fine grained a1 random pyroxene hollow needles	Upper Ultramafics	Spinifex textured komatiite, pyroxene spinifex A2
114.1	114.4	UKSp	fine to v fine grained a1/a2 random hollow pyroxene needles, silicified	Upper Ultramafics	Spinifex textured komatiite, pyroxene spinifex A2

Hole:	*BSD085*				
From	*To*	*Rocktype*	*Description*	*Strat pos*	*Expanded rock name*
310.2	322	UoOCsm	2-4mm olivine, dissem. sub-to euhedral chromite .5mm. EOH.	Lower Ultramafic	Olivine orthocumulate, sago, 2-6mm olivine,

Hole:	*BSD086*				
0	66	saprolite	precollar		
66	78	UoC	precollar	Upper Ultramafics	Olivine cumulate, undifferentiated
78	79.5	UoOC	grey p'blastic talc-carbonate, no texture	Upper Ultramafics	Olivine orthocumulate, undifferentiated
79.5	88.5	UkSo1/2	fine a1 to a2 plates over top 50cm	Upper Ultramafics	Spinifex textured komatiite, A1/A2, olivine
88.5	91.5	UKSo/3	a3 books, core angle 0-30	Upper Ultramafics	Spinifex textured komatiite, olivine spinifex, A3
91.5	110.3	UoOC	grey p'blastic talc-carbonate, no texture	Upper Ultramafics	Olivine orthocumulate, undifferentiated
110.3	112.3	UKSo1/2/3	fine a1 grading to coarse a3 books	Upper Ultramafics	Spinifex textured komatiite, A1/A2/A3, olivine
112.3	116.7	UKSo2	random a2 plates alternating with very fine grained carbonate-chlorite-quartz, no texture, polygonal jointed, probably thin breakouts	Upper Ultramafics	Spinifex textured komatiite, A2, olivine
116.7	117.7	UKSo1	very fine grained a1, polygonal joints, 1cm subspherical felsic vesicles	Upper Ultramafics	Spinifex textured komatiite, A1, olivine
117.7	121.1	UkSo1/2	fine a1/a2 polygonal jointed	Upper Ultramafics	Spinifex textured komatiite, A1/A2, olivine
121.1	121.5	$M	clean pyrite-mill, no inclusions	Upper Ultramafics	Massive sulfide
121.5	123.9	UkSo1/2	a1-a2 as above with a3 122.9-123.4	Upper Ultramafics	Spinifex textured komatiite, A1/A2, olivine
123.9	125.2	Ft+Fbx$	Normally graded volcanic tuff to breccia	Upper Felsics	pyritic crystal tuff and plagioclase-quartz dacite-lithic breccia
125.2	128.1	Fbx+mt	Volcanic breccia + clumps (up to several cm) of fine grained magnetite+chlorite, surrounded by mustard colored fine grained material (siderite), less mt and more carbonate downhole	Upper Felsics	Fbx with magnetite blebs after pyritic clasts?
128.1	130.1	Flst+Fbx$	Intercalated medium and coarse-grained fragmental units	Upper Felsics	pyritic crystal-lithic lappillistone and plagioclase-quartz dacite-lithic breccia
130.1	136.4	Fbx$	Coarse-grained pyritic volcanic breccia, matrix pyrite increases downhole (forming clumps), a little fining as approach lower contact	Upper Felsics	pyritic plagioclase-quartz dacite-lithic breccia
136.4	137.3	Um	Possible Ooc textures, black dendritic mineral, hard	Upper Ultramafics	Undifferentiated ultramafic rock, highly altered
137.3	138.1	Flst+Fbx$	Medium to a coarse-grained unit downhole, clumps of matrix py	Upper Felsics	pyritic crystal-lithic lappillistone and plagioclase-quartz dacite-lithic breccia
138.05	139.6	Um	Dense, green rock, black dendritic mineral again, note no pyrite in these Um layers	Upper Ultramafics	Undifferentiated ultramafic rock, highly altered
139.6	142.8	Fbx$	Coarse to fine-grained units w/ matrix py and py clumps	Upper Felsics	pyritic plagioclase-quartz dacite-lithic breccia
142.8	143	Um	Green, hard (for TC), massive rock	Upper Ultramafics	Undifferentiated ultramafic rock, highly altered

Hole: BSD086

From	*To*	*Rocktype*	*Description*	*Strat pos*	*Expanded rock name*
143	143.6	Fbx$	Volcaniclastic but lots less py, harder to spot clasts	Upper Felsics	pyritic plagioclase-quartz dacite-lithic breccia
143.6	143.8	?$(py)	Gruesome mess	Upper Felsics	
143.8	145	UKM	silicified fault	Upper Ultramafics	Komatiite flow margin, qtz-chlor-carb, no texture
145	147.4	UKSo1	very fine grained a1, polygonal joints, strongly silicified	Upper Ultramafics	Spinifex textured komatiite, A1, olivine
147.35	147.6	vein	Contact: w/ quartz vein running along it	Upper Felsics	
147.55	153.7	Fbx$	Medium-grained volcanic breccia w/ pyrite clumps (decrease in abundance downhole) and unidentified fine grained disseminated opaque	Upper Felsics	pyritic plagioclase-quartz dacite-lithic breccia
153.65	153.7	Contact sharp	Contact: sharp contact but no change in lithology	Upper Felsics	
153.65	160.9	Fbx$	Coarse to very coarse-grained volcanic breccia (increases downhole), intermittent pyrite clasts	Upper Felsics	pyritic plagioclase-quartz dacite-lithic breccia
160.9	161.1	F$	Thick clump of bedded, folded pyrite	Upper Felsics	felsic rock, undifferentiated with sulfide (pyrite)
161.1	165.9	Fbx$	Coarse-grained volcanic breccia with pyrite clumps	Upper Felsics	pyritic plagioclase-quartz dacite-lithic breccia
165.9	170.7	UkSo1/2	fine grained a1/a2, heavily silicified, rare scattered 1cm felsic vesicles, diffuse lower contact. 1cm felsic fragments and inherited phenos in lower 20cm, up to four discrete cooling units	Upper Ultramafics	Spinifex textured komatiite, A1/A2, olivine
170.7	171.5	Flst+Fbx$	Medium-grained volcanic breccia/lapillistone	Upper Felsics	pyritic crystal-lithic lappillistone and plagioclase-quartz dacite-lithic breccia
171.5	171.9	Um?	Stringers of green altered material and sulfide, contaminated Um?	Upper Ultramafics	
171.85	172.6	UKS	very fine grained silicified, cuspate lower contact, 1-2cm penetration of UKM melt into footwall	Upper Ultramafics	Spinifex textured komatiite, undifferentiated
172.6	173.1	Um?	Finger in Fv + quartz veining	Upper Ultramafics	
173.05	177	Fbx$+ UoOC	Coarse to medium-grained volcanic breccia w/ elongate S clumps and contaminated w/ Um	Upper Felsics	
177	180.3	Fbx$	Clast supported, glassy to plagioclase phyric clasts w/ pyrite clumps, faint fabric	Upper Felsics	pyritic plagioclase-quartz dacite-lithic breccia
180.3	181.9	Ft$+Ooc	Harder to spot clasts but still there, 2ndary pyrite increases, S clumps still there, green	Upper Felsics	Ft$ mixed with Um
181.9	181.9	Contact	Contact: broken kom flow top w/ fragments of kom in F		
181.91	182.7	UKS/MBM	fine grained flow top breccia down to massive fine grained basaltic flow, irregular brecciation at lower contact	Lower Ultramafic	
182.7	182.9	Um/F/$	???Check! Blebs of mixed kom, F and sulfide	Lower Ultramafic	
182.9	183.2	UKM/MBM	very fine grained, probable penetration into footwall fracture	Lower Ultramafic	
183.2	183.7	F$	White, fractured F w/ chl-rich veins merges into fine grained-green kom	Upper Felsics	felsic rock, undifferentiated with sulfide (pyrite)
183.7	185	UkSo1/2	a1-a2 silicified	Lower Ultramafic	Spinifex textured komatiite, A1/A2, olivine
185	187.4	UKSo3	a3 olivine books, quartz-carbonate veining, silicified	Lower Ultramafic	Spinifex textured komatiite, A3, olivine

Hole: BSD086

From	To	Rocktype	Description	Strat pos	Expanded rock name
187.4	199	UoOC	grey p'blastic talc-carbonate, no texture, very fine grained dissem. sub-to euhedral chromite	Lower Ultramafic	Olivine orthocumulate, undifferentiated
199	203.5	no core			
203.5	205.3	UKSo2	coarse random a2, olivine plates and skeletal grains	Lower Ultramafic	Spinifex textured komatiite, A2, olivine
205.3	207.6	UoOCf	bladed and skeletal grains in B1 zone in upper 50cm, then fining to sharp basal contact	Lower Ultramafic	Olivine orthocumulate, <2mm olivine,
207.55	207.6	RZ	Contact: w/ chl-Um sharp	Upper Felsics	
207.55	208.3	Fbx	Volcaniclastic w/ mixture of porphyritic F (dacite) and ultramafic clasts	Upper Felsics	plagioclase-quartz dacite-lithic breccia
208.3	209	UKS vesic	fine grained flow top with abundant 2-3cm sulphidic felsic plumes and coalescing vesicles, previously sampled	Lower Ultramafic	Spinifex textured komatiite, vescicular
209	211.8	UKSo1 vesic	medium-coarse grained random olivine, grading into patchy coarse random with possible ghost felsic inclusions, profile sampled	Lower Ultramafic	Spinifex textured komatiite, A1, olivine, vescicular
211.8	230.8	UoOC	fine grained grey p'blastic talc-carbonate, no texture, B zone, very fine grained dissem. sub-to euhedral chromite	Lower Ultramafic	Olivine orthocumulate, undifferentiated
230.8	232.5	UKSo	flow top bx over top 30m	Lower Ultramafic	Spinifex textured komatiite, olivine spinifex
232.5	238.5	UoOC	fine grainedr B zone orthocumulate	Lower Ultramafic	Olivine orthocumulate, undifferentiated
238.5	243	UKSo	patchy preservation of coarse random A2 olivine plates in dark grey p'blastic talc-carbonate	Lower Ultramafic	Spinifex textured komatiite, olivine spinifex
243	250	UoC/UKS	mainly textureless dark grey p'blastic talc-carbonate with minor intervals faintly preserved olivine spinifex	Lower Ultramafic	
250	321.8	UoOCsm	mainly poorly preserved texture in dark-medium grey p'blastic talc-carbonate, rarely preserved patches 2-4mm sago olivine, .5-1mm dissem. sub-to euhedral chromite	Lower Ultramafic	Olivine orthocumulate, sago, 2-6mm olivine,
321.8	340	UoOC(Harr)c	harrisitic olivine cumulate with abundant 2-20mm skeletal, chevron and hopper grains	Lower Ultramafic	Olivine orthocumulate, harrisitic, >6mm olivine
340	346	UKM/UKS	fine grained highly fractured ?flowtop breccia, poorly preservation patches fine grained random pyroxene or olivine	Lower Ultramafic	Komatiite flow margin, possible faint spinifex texture
346	354	UoC	grey p'blastic talc-carbonate, fine dissem. sub-to euhedral chromite, no texture	Lower Ultramafic	Olivine cumulate, undifferentiated
354	355	MKSp	medium-coarse grained pyroxene spinifex, random needles	Lower Ultramafic	High Mg Basalt, px spinifex texture
355	373	UKSo2	mainly medium grained with fine random pyroxene needles and widely spaced coarse olivine plates, alternating random and books, 1-4cm, widely spaced chlorite filled polygonal joints, sample 371.0	Lower Ultramafic	Spinifex textured komatiite, A2, olivine
373	379.3	MKSp2	similar to above but without olivine plates, poorly preserved 1cm random pyroxene needles	Lower Ultramafic	High Mg Basalt, px spinifex texture (A2)
379.3	400	UoOC	no texture, very fine grained dissem. sub-to euhedral chromite	Lower Ultramafic	Olivine orthocumulate, undifferentiated
400	401.2	UoOCf	1-2m olivines down to v sharp contact	Lower Ultramafic	Olivine orthocumulate, <2mm olivine,
401.17	401.8	FL	Contact offine grained chlorite material w/ plagioclase + quartz phyric F, phenos up to 2 mm, coherent	Footwall Felsics	plagioclase-quartz dacite
401.77	433.5	Fbx	Coarse to very-coarse-grained volcanic breccia (up to 60 cm), gs seems to increase downhole as does proportion of clasts (all plagioclase phyric), some pyrite in veins and matrix, nice fabric and alignment in places, altered w/ some talc, pumice.	Footwall Felsics	plagioclase-quartz dacite-lithic breccia

Hole: BSD086

From	To	Rocktype	Description	Strat pos	Expanded rock name
433.5	435.8	Fbx	Same rock but starting to look like contaminated by Um, dissem euh py, looks 2ndary	Footwall Felsics	plagioclase-quartz dacite-lithic breccia
435.75	457	Fbx	Coarse-grained volcanic breccia, clast dominated w/ some alignment/fabric, clasts all plagioclase phyric, some nice jig-saw textures, pumice.	Footwall Felsics	plagioclase-quartz dacite-lithic breccia

Hole: BSD087

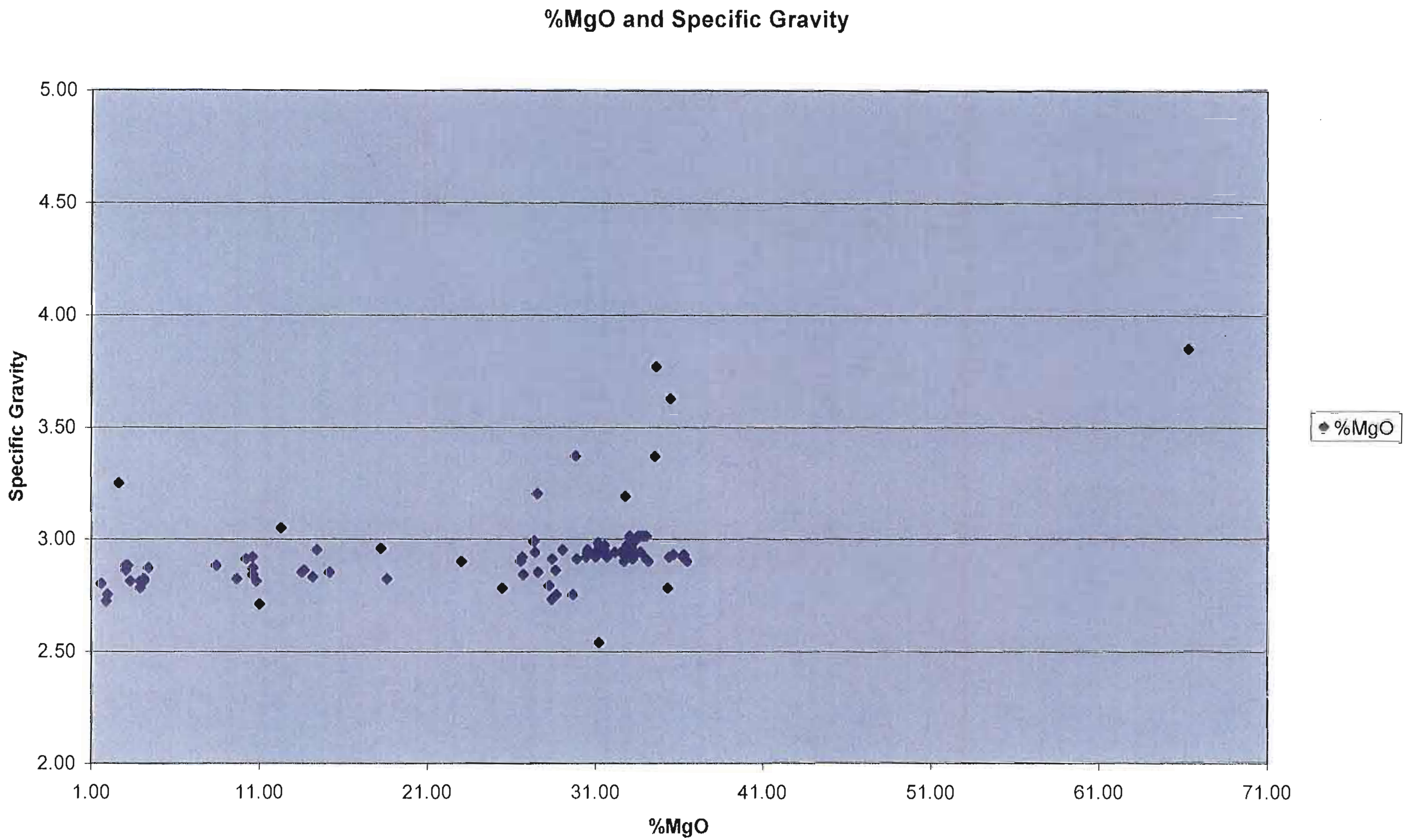
From	To	Rocktype	Description	Strat pos	Expanded rock name
0	81	precollar	Precollar.	Upper Felsics	
81	88.07	Um?	Um??	Upper Ultramafics	
88.07	89.54	MB?	Green highly oxidized fine-grained rock coherent-fragmental? Hard to tell.	Upper Ultramafics	
89.54	92.48	Ft$	Highly altered unit, first few m dark grey to altered green, possible FV and possibly coherent, next ~2m, very complex possibly bedded seq, altered, multicolored grey, green buff, stained to very dark color in places, contains sulfides	Upper Felsics	pyritic crystal tuff
92.48	95.75	MB?	Heavily weathered and stained core (dark oxide staining). Looks coherent in places, blebby in others (both sampled) - greenish color	Upper Ultramafics	
95.75	98.19	Flst+Ft$	Appears to be felsic fragmental rock, fine to med grained clasts. Appears to grade from med grained at top to fine-grained finely bedded unit at base	Upper Felsics	pyritic crystal-lithic lappillistone and plagioclase crystal tuff
98.19	100.1	Flst+Ft$	Definitely fragmental rock, strongly alt and broken core, predom medium grained volcaniclastic breccia, top 60cm - almost unidentifiable although looks coherent, changes into fine to medium grained volcaniclastic breccia mod sorted, lowest 15cm of interval it grades into fine grained possibly bedded rock	Upper Felsics	pyritic crystal-lithic lappillistone and plagioclase crystal tuff
100.1	102.2	Flst+Fbx$	Upper part v-f grained and finely bedded coarsening to medium-grained volcanic breccia/lapilli down core	Upper Felsics	pyritic crystal-lithic lappillistone and plagioclase-quartz dacite-lithic breccia
102.2	127.4	Ul	Rubbly Um flow top (with spx cl), grades into thick random spx sequence extending at least 7m down core, cumulate below, abundant dissem sulfides (mostly pyrite), lowest 20cm is very fine grained, heavily chlorite, with blebs of felsic material and pyrite.	Upper Ultramafics	
127.42	127.7	F	Unidentified green to buff colored, mottled rock which is dominated by euhedral pyrite cubes (</=1cm, mode~30%)	Upper Felsics	felsic rock, undifferentiated
127.65	129.7	Fbx$	medium grained volcaniclastic breccia w/ abundant pyrite clastsl, matrix supported, clast population appears imbricated and possibly with indistinct bedding, matrix fine grained, clasts 5-20% phenos (predom plagioclase </=4mm), pyrite clumps are elongate strips of very fine grained, possibly recryst, pyrit (</= 5cm and »10vol%	Upper Felsics	pyritic plagioclase-quartz dacite-lithic breccia
129.7	167.5	Um	Top of this Um unit has a fine grained chloritized zone grading into spx-text rock over ~6m.	Upper Ultramafics	Undifferentiated ultramafic rock, highly altered
167.45	167.5	Contact	Interval is arbitrary ended at lower contact of the 21cm thick Um finger	Upper Felsics	
167.45	167.5	Contact	Contact is very sharp and unaltered	Upper Felsics	
167.45	168.5	Fbx$+Um	fine to medium grained volcaniclastic breccia invaded by three thin (3-21cm thick) Um fingers, contacts sharp, bound by symmetric, very fine grained 1-10cm quenched margins and with interior of fine, random spx, margins of Um are sharp but irregular and embayed in places	Upper Felsics	Fbx$ mixed with Um
168.45	173.8	Fbx$	fine to medium grained volcaniclastic breccia with rare coarse grained clasts, continuous clast range from sub mm - 5cm, indistinct bedding and clast imbrication, scattered pyrite clumps, as in above felsics, present, up to </=10%vol, size »2-5cm long, also dissem py	Upper Felsics	pyritic plagioclase-quartz dacite-lithic breccia
173.81	173.9	Um	Thin 4cm Um vein.	Lower Ultramafic	Undifferentiated ultramafic rock, highly altered

From	To	Rocktype	Description	Strat pos	Expanded rock name
Hole:	**BSD111**				
391.25	391.3	Contact	HW is all Um with possible Mi. "FW": Contact at low angle to core.		
391.25	401.3	FL/Ft	Strongly veined (quartz/carbonate), co-looking or a tuff/ss, variable proportion of poss feldspars phenos up to 3mm in size. 30-60% phenos. Appears to be rare quartz crystals <1mm, lowest 1m may be a volcaniclastic breccia or just tectonized.	Footwall Felsics	plagioclase-quartz dacite or felsic tuff
401.3	420.1	Ft	very fine grained massive "sandstone" (fine grained), cut sections appears to show clastic texture, intercalated and/or cut by cm-thick black extremely fine grained material (sometimes w/ fragments from the SS), unit deformed and heavily cut by veins, see long logs	Footwall Felsics	crystal tuff
401.3	401.3	Contact	Core is very broken but appears to be a sharp contact.	Footwall Felsics	
420.1	421.1	Ft?	Unit may be including bits of SS right at contact (?) Coherent, very fine grained unit, aphyric, has distinct banding (flow banding/foliation?).	Footwall Felsics	crystal tuff?
420.1	420.1	Contact	Sharp irregular contact	Footwall Felsics	
421.1	424	Ft?	EOH. Sandstone continues as above but heavily altered and may be tectonized. Broken into what looks like breccia but may be a secondary effect of tectonism/def and differential alteration Also veined with quartz/carbonate.	Footwall Felsics	crystal tuff?
Hole:	**BSD112**				
120	130	UoC	dark grey coarsely porphyroblastic talc carbonate, no texture preserved, 1mm lob chromite, 2-8mm carbonate porphyroblasts	Lower Ultramafic	Olivine cumulate, undifferentiated
130	135	UoMCm	as above, patches with faint ghost of 3-5mm ovoid close packed olivine, very poorly preserved texture	Lower Ultramafic	Olivine mesocumulate, undifferentiated, 2-6mm olivine
135	145	UoC	dark grey coarsely porphyroblastic talc carbonate, no texture preserved, 1mm lob chromite, 2-8mm carbonate porphyroblasts	Lower Ultramafic	Olivine cumulate, undifferentiated
145	147	UoMCsc	3-7mm random ovoid olivines, close packed, 1mm lob chromite, texture preserved in carbonate-rich intervals, otherwise no texture preserved	Lower Ultramafic	Olivine mesocumulate, sago textured, >6mm olivine
147	205	UoMCsc	3-7mm random ovoid olivines, close packed, 1mm lob chromite	Lower Ultramafic	Olivine mesocumulate, sago textured, >6mm olivine
205	222	UoMCs	transition to serpentinite	Lower Ultramafic	Olivine mesocumulate, sago textured
222	238	UoMCm	2-5mm equant olivine, 1mm lob chromite, black antig serpentinite	Lower Ultramafic	Olivine mesocumulate, undifferentiated, 2-6mm olivine
238	280	UoOCm	2-5mm equant olivine, 1mm lob chromite, partly serpentinised with abundant fresh olivine showing prominent cleavage, sparse 1mm lob chromite	Lower Ultramafic	Olivine orthocumulate, 2-6mm olivine,
280	292	UoOCbm	2-5mm equant olivine, 1mm lob chromite, partly serpentinised with abundant fresh olivine showing prominent cleavage, sparse 1mm lob chromite, scattered elongate 1cm olivine phenos	Lower Ultramafic	Olivine orthocumulate, bimodal, 2-6mm olivine,
292	294.6	UoOC	black serpentinite, no phenos, v abrupt sharp contact with talc carbonate at bottom	Lower Ultramafic	Olivine orthocumulate, undifferentiated
294.6	331.5	UoC	black coarsely porphyroblastic talc carbonate, no texture preserved	Lower Ultramafic	Olivine cumulate, undifferentiated
331.5	362.5	UoMCf	1x3mm adcumulate olivine in dark green-grey serpentinite, some fresh olivine, 2mm lob to poikilitic chromite	Lower Ultramafic	Olivine mesocumulate, undifferentiated, <2mm olivine
362.5	369	UoC	black porphyroblastic talc carbonate, no texture preserved	Lower Ultramafic	Olivine cumulate, undifferentiated

Hole: BSD112

From	To	Rocktype	Description	Strat pos	Expanded rock name
369	453.6	UoMCm	2-3mm equant to weakly bladed olivine, patchy texture in carbonate rich units, 1cm porphyritic magnetite (overgrown on chromite) in some carbonate-rich intervals, grain size layered on 10m scale with olivines to 8mm	Lower Ultramafic	Olivine mesocumulate, undifferentiated, 2-6mm olivine
453.6	468.6	UoC	black porphyroblastic talc carbonate, no texture preserved	Lower Ultramafic	Olivine cumulate, undifferentiated
468.6	468.9	UoC?	brecciated, quartz veined, folded fragments in quartz vein matrix, fragments containing weak carbonate-chlorite schistosity	Lower Ultramafic	
468.9	469.1	qv		Lower Ultramafic	
469.1	469.5	UKM	fine grained, strongly schistose, tr dissem $	Lower Ultramafic	Komatiite flow margin, qtz-chlor-carb, no texture
469.5	483	Ibxw	Sparsely feldspars phyric, intensely welded, coarse grained clast supported Ibx (also has medium grained and very coarse grained clasts), very pale yellowish green. Dissem py, in places: clastic texture almost completely obliterated	Footwall Felsics	clast-deformed plagioclase dacite-lithic breccia
482.95	484	IL-Ibx	Strongly sheared and heavily veined by quartz - possibly fragmented co-rock.	Footwall Felsics	IL with lenses of Ibx
484	488.7	IL	Shearing disappears but still veined by quartz veins, aphyric to very sparsely phyric (feldspars?), very fine grained coherent unit. Pale colours, buff/green. More dissem pyritehere. BSD112-485.5	Footwall Felsics	plagioclase dacite
488.65	488.9	Um	Um finger - buff green to dark green - strongly sheared/banded with carb, fine grained + chromites.	Footwall Felsics	Undifferentiated ultramafic rock, highly altered
488.89	512.5	IL	Same as co unit as above. Rare feldspar crystals and possibly chloritized mafics, salmon pink zones: gradational change from rest of unit and poss result of alteration/not a change in lithology, 20cm autobreccia (?) zone at ~510.2m.	Footwall Felsics	plagioclase dacite
512.5	512.5	Contact	Sharp transition	Footwall Felsics	
512.5	524	Ibxw	Densely welded breccia - no change in lithology - distinct colour changes but no distinct change in lithology - may be a function of alteration, coarse to medium grained probably clast supported, 519m welding decreases down-core and start to see sparse mm feldspars phenos	Footwall Felsics	clast-deformed plagioclase dacite-lithic breccia
524	531.5	Ibx	Non-welded clast supported, medium to coarse grained, sparse plagioclase clasts (<1mm) (between 528-530.5m core is a med grey and looks more like typical FW). Note most of FW is very bleached except in zones such as that noted above where can see textures better.	Footwall Felsics	plagioclase dacite-lithic breccia
531.5	537.5	Ibxw+Um?	Welded volcaniclastic breccia. @531.9m, 15cm; @535.2m, 20cm; @536.6m, irregular veins of fine grained avocado green material. Moderate to densely welded breccia. Welding most intense in middle and decreases towards edges, medium to coarse grained, clast supported.	Footwall Felsics	clast-deformed plagioclase dacite-lithic breccia +Um?
537.5	539.3	Ibxw	Poorly to intensely welded breccia, welding increases down to 529.3m, medium to coarse grained, clast supported.	Footwall Felsics	clast-deformed plagioclase dacite-lithic breccia
539.3	540.9	IL	Coherent interval. Phyric, can see chloritized mafics (amph?).	Footwall Felsics	plagioclase dacite
540.85	552.1	Ibxw	Mod-intensely welded medium to coarse grained breccia, clast supported.	Footwall Felsics	clast-deformed plagioclase dacite-lithic breccia
552.05	560.9	IL	Another co-zone, no noticeable change in lithology from Ibxs, though. Upper contact is in broken core, unit is pale brownish-grey to reddish brown.	Footwall Felsics	plagioclase dacite
560.85	560.9	Contact	Sharp	Footwall Felsics	
560.85	566	Ibxw	Intensely welded breccia which grades into mod-incipiently welded bx.	Footwall Felsics	clast-deformed plagioclase dacite-lithic breccia

Appendix 8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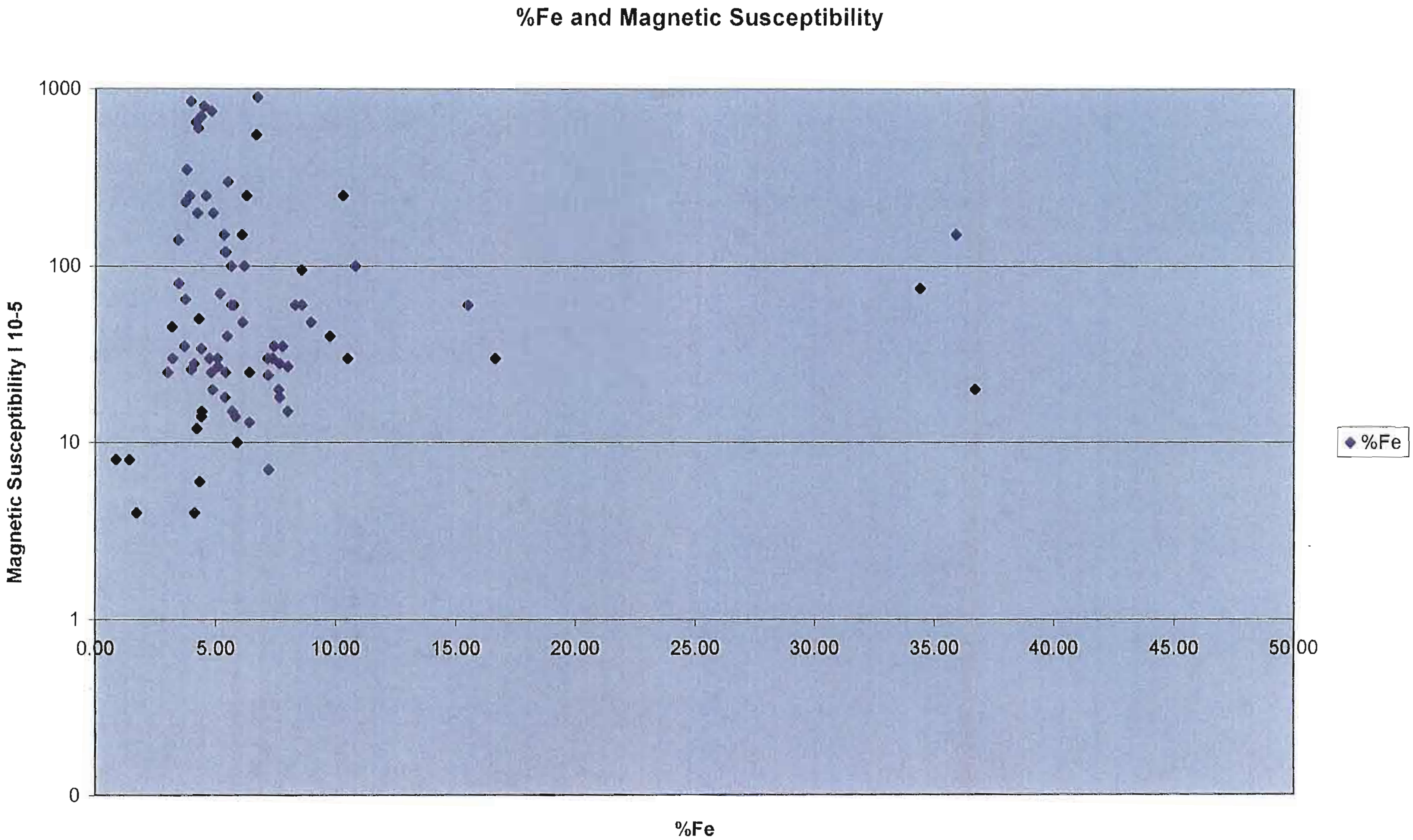
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45.00
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%Fe
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CSIRO annotated level plan of the Black Swan succession

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